STAR

Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL

OCTOBER 8, 1968

VOLUME 6 • NUMBER 19

N68-30864—N68-32189

D J..IENTS DEPT.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Duke University Library

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

Semimonthly issues...

Annual subscription rate: $33, domestic; $42, foreign. Price per single copy: $2.25, domestic; 25c extra for foreign mailing.

Cumulative index issues...

Annual subscription rate: $30, domestic; $35, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates...

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates...

Apply to Argentina, Brazil, French Guiana, Guyana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

Scientific and Technical Aerospace Reports, Volume 6, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Eng'g.
2629.13
U58TA
v.6
1968
NO. 19-24

SPECIAL NOTICE

This issue contains the first *STAR* indexes to be produced by the U. S. Government Printing Office on its special Linotron photocomposing equipment.

The Subject and Personal Author Indexes were reproduced from copy generated by Linotron; the other indexes were prepared from Computer Printout. Variations in the appearance of the Indexes, resulting from production problems during transition between photocomposing systems, should in no way affect the content of the indexes.

Introduction

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

The following publications are abstracted in *STAR*:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

HOW *STAR* IS ORGANIZED

The first section of *STAR* contains citations and abstracts arranged in 34 subject categories. Following are five indexes: subject, personal author, corporate source, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, the fourth quarterly being an annual index for the calendar year. Cumulative indexes also contain a contract number index.

HOW TO USE *STAR*

Readers are encouraged to examine abstracts in each subject category of interest. If time is short, readers may wish to scan the subject index for items of interest in a specific area. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject index in the quarterly cumulative indexes.

AVAILABILITY OF *STAR* AND DOCUMENTS CITED

NASA documents (identified by an asterisk in the abstract section and in the report/accession number and accession/report number indexes) and *STAR* are available without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public use;
4. Other organizations in the United States having a need for NASA documents in work related to the aerospace program; and
5. Foreign government or academic organizations that have established reciprocal arrangements for the exchange of publications with NASA, that have current agreements for scientific and technical cooperative activities with NASA, or that have arrangements with NASA to maintain collections of NASA documents for public use.

European requesters may purchase facsimile copy or microfiche of NASA documents, identified by the sign (#), from ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av. de Neuilly, 92-NEUILLY sur Seine, France.

Advisory Group for Aerospace Research & Development (AGARD) reports that are not copyrighted are made available on the same basis as NASA documents.

Department of Defense documents (identified by the "AD" number in the citation) are available subject to a service charge in hard copy or microfiche form from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Microform copy of DOD reports will continue to be available to Defense Documentation Center (DDC) users at no cost from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia 22314.

Other nonNASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.

Documents that have been placed on microfiche (a transparent sheet of film, approximately 4"×6" in size, capable of containing an arrangement of 60 or more pages of information reduced to micro images) are identified with the symbol #. Microfiche are available on the same basis as hard copy

HOW TO REQUEST LISTED DOCUMENTS

If you are registered with NASA, send a complete *Document Request* (Facility Form 492) to:

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

If you are not registered with NASA, but are eligible to receive documents without charge according to the information on the previous page, request Registration Form—Technical Publications (Facility Form 713)

HOW THE PUBLIC MAY OBTAIN LISTED DOCUMENTS

For reference purposes, NASA documents listed in *STAR* may be consulted at the organizations listed on the inside back cover. Commercial publications listed in *STAR* may be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents and noncopyrighted foreign documents, including AGARD reports, from either of the following sales agencies, as identified in the abstract section:

Clearinghouse for Federal Scientific and Technical Information
(CFSTI)
Springfield, Virginia 22151

Superintendent of Documents, U.S. Government Printing Office
(GPO)
Washington, D.C. 20402

Documents available from CFSTI are sold in hard copy and microfiche form. If a printed hard copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" (hard copy) for full size or facsimile; "MF" for microfiche. A unit price policy has been established by CFSTI: $3.00 for printed hard copy or facsimile copy; $0.65 for microfiche.

Not all NASA documents, however, are subject to this policy. Documents available from Superintendent of Documents (which are also available from CFSTI) are sold at the Superintendent of Documents price, and other selected NASA publications are not governed by the unit price policy. In all cases, the *STAR* citation includes the sale price.

In the citation of each NASA-supported document is a code, e.g., CSCL 25A that indicates the subject category assigned to it from the *COSATI Subject Category List* (first ed., December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

The public may request nonNASA documents by writing to the source or to other information systems. Bibliographic information, e.g., report number, etc., rather than the NASA accession number (i.e., N68-12345) should be provided when requesting such a document.

ABSTRACTS OF JOURNAL ARTICLES

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A, Washington, D. C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N. Y. 10017.

Annual subscription rates for *IAA*:

Semimonthly issues: United States and Possessions, $33 postpaid; Foreign Countries, $42 postpaid.

Cumulated Index Volumes: United States and Possessions, $30 postpaid; Foreign Countries, $35 postpaid.

INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at $8.50 for the three-volume set.

Volume 6 Number 19 / October 8, 1968

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page:

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **3193**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **3197**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **3201**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **3207**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **3214**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **3219**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **3235**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **3245**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 3251

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 3254

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 3258

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 3260

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 3267

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 3275

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. 3283

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 3287

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 3287

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 3296

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 3299

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **3303**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **3305**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **3308**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **3314**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **3319**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **3337**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **3345**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **3357**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **3358**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **3360**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **3362**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. 3372

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. 3374

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. 3383

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. 3388

SUBJECT INDEX I-1

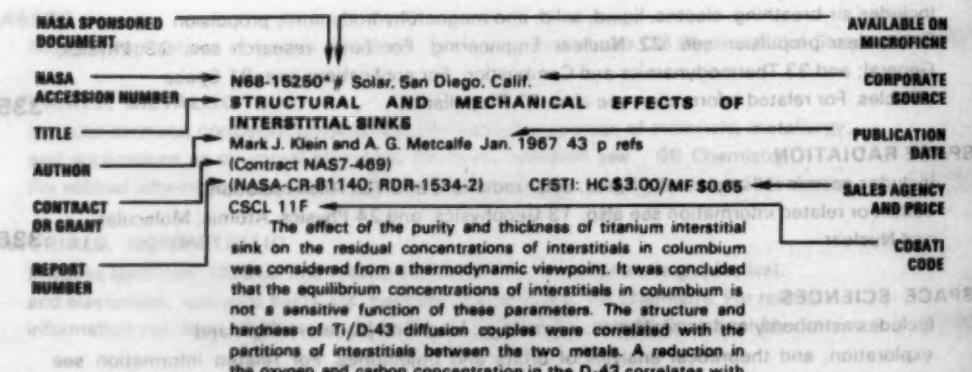
PERSONAL AUTHOR INDEX I-75

CORPORATE SOURCE INDEX I-107

REPORT/ACCESSION NUMBER INDEX I-135

ACCESSION/REPORT NUMBER INDEX I-147

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N68-15250* # Solar, San Diego, Calif.
CORPORATE SOURCE
TITLE
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
PUBLICATION DATE
AUTHOR
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
CONTRACT OR GRANT
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
SALES AGENCY AND PRICE
CSCL 11F
REPORT NUMBER
CODATI CODE
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 6 NUMBER 19 / OCTOBER 8, 1968

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-31039# Aeronautical Research Council (Gt. Brit.).
LEADING EDGE EFFECTS ON CARET WINGS
J. C. Cooke 1968 21 p refs Supersedes RAE-TN-Aero-2943, ARC-25840
(ARC-CP-976; PD-3682; RAE-TN-Aero-2943; ARC-25840; AD-833489) CFSTI: HC$3.00/MF$0.65

The two planes of the lower surface of a caret wing are treated as though they were infinite and swept, and the leading edge shock boundary layer interaction for each is investigated. It is found that the shock shapes are curved near to the leading edge and the pressure there is higher than the design pressure. However, in certain circumstances each shock may soon become parallel to the design shock and the pressure near to its design value. In extreme conditions this may never happen and for these cases it is concluded that the design is not achieved. A tentative condition for the achievement of design conditions is given. Author (TAB)

N68-31066# Royal Aircraft Establishment, Farnborough (England).
SOME INVESTIGATIONS INTO WINGS WITH LEADING EDGE FLAPS WITH AND WITHOUT FUSELAGE [EINIGE UNTERSUCHUNGEN AN NASENKLAPPENFLUGGELN KLEINER STRECKUNG MIT UND OHNE RUMPF]
Fred Thomas Dec. 1967 20 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), no. 2, 1963 p 439-446
(RAE-LIB-TRANS-1268) CFSTI: $3.00

Three-component measurements were carried out in the low-speed wind tunnel with sweptback wings with leading edge flaps and trailing edge flaps. For the three wings investigated, the angle of sweep varied from $\phi = 0°$ to 57.3°, and the taper ratio from $\lambda = 1$ to 1-8, while the aspect ratio $A = 2$ and the airfoil section NACA 0005 were constant. The flaps extend over the outer 75% of the span, the trailing edge flaps being continuous and the leading edge flaps in three sections. The three wings were tested not only alone but also in combination with a fuselage. The largest increment in lift due to deflection of the leading edge flaps is in the region of $\Delta C_{L\ max} = 0.3$. Additional deflection of the trailing edge flaps increased the increment in lift to $\Delta C_{L\ max} = 0.5$. In order to enable a comparison to be made with theory, the Truckenbrodt lifting surface theory was applied to the airfoil with leading edge flaps. Comparing test results with theory the agreement was satisfactory with regard to pitching moments, but unsatisfactory for the lift. Author

N68-31260*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED CONCEPTS TO INCREASE TURBINE BLADE LOADING
Warner L. Stewart and Arthur J. Glassman Washington 1968 15 p refs To be presented at the Ann. Meeting and Energy Conversion Exposition sponsored by ASME, New York, 1-5 Dec. 1968
(NASA-TM-X-52445) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Blade loading is examined in terms of surface diffusion and loading effectiveness parameters. These parameters serve to define the level of loading, with higher values of each representing higher loading on the blade. Advanced blading concepts designed for efficient utilization of high values for each of these factors are discussed. Experimental results demonstrating these design concepts are presented. Author

N68-31284# Waterloo Univ. (Ontario). Mechanical Engineering Dept.
PERFORMANCE OF THICK TURNING VANES AND THIN TURNING VANES WITH EXTENDED TRAILING EDGES IN SQUARE CONDUITS
S. Ahmed and E. Brundrett Jul. 1968 26 p refs
(TN-8) CFSTI: HC$3.00/MF$0.65

Results of investigations in a right angled elbow in a 2 foot square duct are given. Experiments were carried out on thick turning vanes, thin turning vanes with tangentially extended trailing edges, and thin truncated turning vanes (boundary fences). The performance was studied in respect to the velocity profiles at a fixed downstream location, the loss coefficient, and the secondary flow coefficient. The studies covered the Reynolds number range up to 4×10^5. In general the loss coefficients were higher and secondary flow coefficients lower than for the thin turning vane case. However, for the case of boundary fences, no improvement in the performance over that without any turning vanes was seen. It was also found that the loss coefficient approaches a constant value with increasing Reynolds number for a particular geometry and that the aspect ratio of the passage between the vanes for least loss should be approximately 8. Author

N68-31354*# Techtran Corp., Glen Burnie, Md.
APPLICATION OF BLOWING AT THE TRAILING EDGE TO THE CONTROL OF CASCADES [APPLICATION DU SOUFFLAGE AU BORD DE FUITE AU CONTROLE DE LA DEFLEXION DES GRILLES D'AUBES]
J. Paulon Washington NASA Jul. 1968 3 p refs Transl. into ENGLISH from Rech. Aeron. (Chatillon-Sous-Bagneux), no. 67, Nov.–Dec. 1968 p 56–57
(Contract NASw-1695)
(NASA-TT-F-11850) CFSTI: HC $3.00/MF $0.65 CSCL 01A

As mechanical complications often accompany distributor adjustments made to improve operating flexibility of turbojets, cascade wind tunnel experiments were conducted to simulate these aerodynamic effects by blowing air at the trailing edge. Symmetrical blades, equipped near their truncated trailing edge with a thin slot extending over their whole span, are placed in the stream at a zero incidence angle forming a straight cascade of relative gap $\epsilon = 0.916$. The compressed air flow and the jets are regulated to control flow periodicity. The deflection angle θ given by the cascade is measured in the plane of the halfspread about one chord downstream from the trailing edges. Under these conditions θ depends, as a first approximation, only on the ratio $C\mu$ between the momentum of each jet and the general air flow through one channel of the cascade. An equation is derived to show that, for a given value of $C\mu$, θ decreases very slowly as the relative gap of profiles beyond the usual values of $\epsilon \approx 1$ increases. It is concluded that the experiment confirms the possibility of obtaining deflections for a given generating pressure of auxiliary air without larger air flow for turbine wheels with few blades. M.G.J.

N68-31439# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
EXACT THEORY FOR THE STABILITY OF CARET WINGS IN HYPERSONIC FLOW
W. H. Hui [1967] 45 p refs
(AASU-284) CFSTI: HC $3.00/MF $0.65

Exact theory for the stability derivatives of a pitching caret wing at its design condition in hypersonic and high supersonic flows are obtained by using the perturbation method developed for wedges. A general criterion for the stability of caret wings is also obtained. Both stiffness and damping derivatives of a caret wing are shown to be independent of its aspect ratio but dependent only on the flight Mach number and the incidence of its lower ridge. The three-dimensional effect of the flow is shown to greatly increase the damping derivative for forward pivot positions and to decrease it for rearward pivot positions. Illustrating examples are included. Author

N68-31440*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Aeronautical Engineering and Astronautics.
PLANE-FLAME SIMULATION OF THE WAKE BEHIND AN INTERNALLY PROPELLED VEHICLE. PART 3: EXPERIMENTAL SIMULATION OF A SUPERSONIC VEHICLE BY A DETONATION
John H. Skinner, Jr. Nov. 1967 41 p Sponsored in part by NASA
(Contract C-117-66; Proj. Tubeflight)
(NASA-CR-96123; TR-AE-6708; PB-176924) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The flow field induced by an internally-propelled vehicle traveling through a tube at a supersonic speed is simulated experimentally by the flow field induced by a detonation. The results indicate that as the vehicle continues to travel at a constant velocity, the effects of friction and heat transfer cause a region of flow to develop which is steady in the frame of reference of the vehicle. This steady-flow region starts directly behind the vehicle and gradually grows to fill the entire flow field as time progresses. Author (USGRDR)

N68-31445*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AERODYNAMIC STABILITY CHARACTERISTICS OF THE APOLLO COMMAND MODULE
William C. Moseley, Jr., Ralph E. Graham, and Jack E. Hughes Washington Aug. 1968 171 p refs
(NASA-TN-D-4688) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Results from wind-tunnel tests conducted during the design and development of the Apollo command module are presented. Investigations were made to develop static and dynamic stability data for the basic configuration of the command module. Parametric studies were conducted to determine the effects of varying certain geometric dimensions of the basic command module configuration. Studies of modifications designed to provide an increased lift-to-drag ratio were also conducted. Representative samples, from an extensive series of tests of alterations designed to eliminate an apex-forward trim condition, are included. Author

N68-31472# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF THE PROBLEM OF A HYPERSONIC GAS FLOW AROUND AN ELONGATED BLUNTED BODY BY THE G. G. CHERNYY APPROXIMATE METHOD [RESHENIYE ZADACHI OBTEKANIYA GIPERZVUKOVYM POTOKOM GAZA UDLINENNOGO ZATUPLENNOGO TELA PRIBLIZHENNYM METODOM G. G. CHERNOGO]
S. S. Grigoryan 3 May 1967 12 p ref Transl. into ENGLISH from Arch. Mech. Stosowanej (Poland), v. 16, no. 3, 1964 p 571–576
(FTD-HT-66-704; AD-670896)

The flow field around an axisymmetric body at zero angle of attack was studied analytically using Chernyys method of approximation. The analysis is valid for streamlines inclined at shallow angles, and hence the solution is limited to a region aft of the blunt tip of the body. Author (TAB)

N68-31484*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN OF BODIES TO PRODUCE SPECIFIED SONIC-BOOM SIGNATURES
Raymond L. Barger Washington Aug. 1968 10 p refs
(NASA-TN-D-4704) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A mathematical procedure is described for calculating the shape of a body of revolution that will generate a specified signature at a given Mach number and lateral spacing from the body. The applicability of the method is contingent on the requirement that the signature be physically obtainable. Results of a wind-tunnel study with three sample bodies support qualitatively the validity of the theory. Author

N68-31515*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MODIFIED MULTIHOPP APPROACH FOR PREDICTING LIFTING PRESSURES AND CAMBER SHAPE FOR COMPOSITE PLANFORMS IN SUBSONIC FLOW
John E. Lamar [1968] 143 p
(NASA-TN-D-4427, Sup.) CFSTI: HC $3.00/MF $0.65 CSCL 01A

This supplement contains information about the two main computer programs (Langley computer program A0313, loading program, and Langley computer program A0457, mean camber program) used to obtain the results presented in NASA Technical Note D-4427 along with two supplementary programs (Langley computer program A1590, aspect ratio program, and Langley computer program A1591, pivot determining program) used in obtaining input data for them. In part I of this supplement, the input and some output variables for each of the two main programs (A0313 and A0457) are presented and pertinent comments made.

Further, sample listings of input and output data are shown and the entire computer program listings provided. In part II of this supplement, a discussion of the two supplementary programs is presented with a list of input data required, and sample input and output listings as well as program listings are given. Author

N68-31551*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMICS OF LARGE-ANGLE CONES
James F. Campbell and Dorothy T. Howell Washington Aug. 1968 71 p refs
(NASA-TN-D-4719) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation has been made to determine the supersonic aerodynamics of a series of conical bodies with semiapex angles from 40° to 90° (disk). The tests were performed at Mach numbers from 2.30 to 4.63, at angles of attack from −4° to 24°, and at a Reynolds number based on model (base) diameter of 0.8×10^6. These data were compared with those predicted by exact cone theory, modified Newtonian theory, and an integral relations method. Results of this study indicated that all the configurations are statically stable with the center of gravity located at the model base. As the cone semiapex angle is increased, axial force increases, the rate of increase being largest between 40° and 50° cone configurations. Experimental values of axial force at an angle of attack of 0° are adequately predicted for all cone semiapex angles by utilizing a combination of exact theory and an integral relations method. As the cone semiapex angle is increased, normal force decreases, normal force being zero for the flat disk. Shock standoff distance varies almost linearly with cone semiapex angle and the inverse of Mach number squared; these trends are adequately predicted by an integral relations method. Author

N68-31556*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
INVESTIGATION OF FLOW STRUCTURE DOWNSTREAM OF A CONE IN SUPERSONIC FLOW [ISSLEDOVANIYE STRUKTURY TECHENIYA ZA KONUSOM V SVERKHZVUKOVOM POTOKE]
Yu. A. Panov and A. I. Shvets Washington NASA Aug. 1968 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 2, 1967 p 140–143
(Contract NASw-1692)
(NASA-TT-F-11877) CFSTI: HC $3.00/MF $0.65 CSCL 01A

In the study reported here, schlieren photography, pressure sensors, and mechanical means of visualization were used to determine the pattern of pressure, motion, and flow regimes in the wake of a sharp cone in a Mach-3 flow. The nonuniform wake flow is found to exhibit an intensive central jet coming upstream to the cone's base and a toroidal eddy zone between the central jet and the jet boundary of the wake. Author

N68-31584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INDUSTRIAL AERODYNAMICS, NO. 23
Ye. Ye. Solodkin and A. S. Ginevskiy 14 Sep. 1967 71 p refs Transl. into ENGLISH from Prom. Aerodinamika (Moscow), no. 23, 1962 p 5-65
(FTD-MT-66-171; AD-671146)

Contents: Question of the possibility of the use of models of turbulent flow of Prandtl and Taylor in the solution of problems on the turbulent flow of gas in the absence of rigid boundaries; Turbulent nonisothermal jet flows of compressible gas. TAB

N68-31653# National Physical Lab., Teddington (England). Aerodynamics Div.
AERODYNAMIC TESTS ON A VENTURI SCRUBBER
D. E. Walshe and A. Vallence (Lodge-Cottrell, Ltd.) May 1967 26 p refs
(NPL-AERO-1235) CFSTI: HC $3.00/MF $0.65

Measurements were made of the pressure loss through a duct system incorporating a venturi scrubber, and of the aerodynamic torque and stability characteristics of the scrubber plate. It is explained how to apply the results to any geometrically similar duct system. Author

N68-31683# Lockheed Missiles and Space Co., Palo Alto, Calif.
MODELING THE FLEXURAL-TORSIONAL WING OSCILLATIONS IN AN AIR FLOW (DETERMINATION OF THE CRITICAL FLUTTER VELOCITY)
P. S. Landa, Yu. V. Ponomarev, and S. P. Strelkov 5 May 1966 7 p refs Transl. into ENGLISH from Mekh. Tverdogo Tela (USSR), no. 3, 1967 p 186–191
(PB-177191T) CFSTI: HC $3.00/MF $0.65

The method of determining the eigenfunctions and eigenvalues of systems described by one-dimensional partial differential equations by utilizing electronic analog computers is applied to the problem of wing oscillations in an air flow to determine the critical flutter velocity and frequency. USGRDR

N68-31691# Rensselaer Polytechnic Inst., Troy, N. Y.
AERODYNAMIC CHARACTERISTICS OF GROUND SUPPORT SYSTEMS
Robert E. Duffy and George C. Cooke, IV Jan. 1968 119 p refs
(Contract C-117-66; Grant NSF GK-618)
(TR-AE-6801; TR-AE-6804; PB-177521) CFSTI: HC $3.00/MF $0.65

Two reports dealing with the aerodynamic characteristics of ground support systems are presented. The first report "Aerodynamic Characteristics of a Tubeflight Vehicle Support System" by Robert E. Duffy presents experimental data on an aerodynamic ground-support system obtained in a moving wall wind tunnel. The second report "Jet-Flapped Airfoils in Ground Proximity" by George C. Cooke concerns a study of the subsonic lift characteristics of airfoils in ground proximity with and without trailing-edge jet flaps. This study was restricted to a supercritical flow analysis. Author (USGRDR)

N68-31693# Rensselaer Polytechnic Inst., Troy, N. Y.
THREE NOTES ON PROPULSION AND BREAKING OF TUBEFLIGHT VEHICLES
Joseph V. Foa Mar. 1968 110 p refs
(C-117-66; Proj. Tubeflight)
(TR-AE-6708; TR-AE-6802; TR-PT-6801; PB-177520) CFSTI: HC $3.00/MF $0.65

The report consists of the following articles: Tubeflight propulsion by bladeless fans; Power demands of tubeflight vehicles; Preliminary evaluation of the braking capabilities of tubeflight vehicles. Author (USGRDR)

N68-31722
RAREFIED GAS FLOW AROUND AN OBSTACLE
M. L. Kagan [1968] 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Mat. Mekhn. (USSR), no. 3, 1968 p 108–113
CFSTI: HC $3.00/MF $0.65

A method is proposed for solving problems on hypersonic rarefied gas flow around an obstacle in an almost free molecular flow regime. The aerodynamic characteristics of an infinite plate at an arbitrary angle of attack to the free stream are computed. Author

N68-31820# Pennsylvania State Univ., University Park. Ordnance Research Lab.
LIFT OF A FINITE JET-FLAPPED CASCADE OF AIRFOILS AT LARGE JET ANGLES
M. Salita 16 May 1967 79 p refs
(Contract NOw-65-0123-d)
(TM-510.2481-06; AD-670728)

An expression for the lift coefficient of a cascade of a finite number of jet-flapped airfoils with connecting endplate was developed by analytical and semi-empirical means. The analysis is independent of angle of attack, and is verified experimentally for a six-vane cascade at zero angle of attack with a jet-flap angle of 90 degrees. Author (TAB)

N68-31858# Boeing Co., Morton, Pa. Vertol Div.
IN-FLIGHT MEASUREMENT OF ROTOR BLADE AIRLOADS, BENDING MOMENTS, AND MOTIONS, TOGETHER WITH ROTOR SHAFT LOADS AND FUSELAGE VIBRATION, ON A TANDEM ROTOR HELICOPTER. VOLUME 1: INSTRUMENTATION AND IN-FLIGHT RECORDING SYSTEM
Roy Golub and William McLachlan May 1967 170 p refs
(Contract DA-44-177-AMC-124(T))
(D8-0382-1; USAAVLABS-TR-67-9A; AD-670952)

An extensively instrumented tandem rotor helicopter was developed to measure the rotor blade airloads and the resulting rotor blade motions and bending moments, rotor shaft loads and moments, and fuselage vibration. The report details the design, assembly, and testing of the instrumentation system and documents the capability of the system for fulfilling the requirements of the program. The selection and testing of the system components are described in detail, along with the integration of these components into the overall instrumentation and recording system. The exhaustive tests of the system, both on the ground and in flight, are described in step-by-step sequence. The capacities and capabilities of the system are delineated and illustrated. Four technical appendixes, giving precise engineering data and statistical records, are included in the report. Author (TAB)

N68-31859# Boeing Co., Philadelphia, Pa. Vertol Div.
TWO-DIMENSIONAL TEST OF AIRFOILS OSCILLATING NEAR STALL. VOLUME 1: SUMMARY AND EVALUATION OF RESULTS Final Technical Report
Jaan Liiva, Franklyn J. Davenport, Lewis Gray, and Ivor C. Walton Apr. 1968 147 p refs
(Contract DA-44-177-AMC-438(T))
(D8-0678-1; USAAVLABS-TR-68-13A; AD-670957)

An experimental investigation into rotor blade dynamic stall was conducted. Two typical airfoils, the NACA 0012 (modified) and the Vertol 23010-1.58, were tested by measuring the differential pressures acting during pitching and translatory oscillations over a range of angles of attack covering the stall regime. There were two main objectives. The first was to determine the influence of stall on the aerodynamic pitching moment of an airfoil executing pitching motions corresponding to the elastic torsional oscillations of a rotor blade. The second was to determine the extent to which time-varying angle of attack could affect the maximum aerodynamic lift that a rotor blade can develop. The cambered profile remained free of negative damping for 3 to 6 degrees beyond the point where the symmetrical section encountered negative damping in the Mach 0.2 to 0.4 range. The cambered section exhibited higher attainable C sub Ns than the symmetrical section under all conditions of motion, except for the highest frequency tested at Mach 0.6. Author (TAB)

N68-31864# ARO, Inc., Arnold Air Force Station, Tenn.
EXPANSION SIDE FLOW FIELD IMPACT PRESSURE SURVEYS OF A 75-DEG DELTA WING AT MACH NUMBER 10
C. J. Spurlin Arnold Eng. Develop. Center Jun. 1968 16 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-58; AD-670512)

Impact pressure surveys were obtained in the leeward flow field of a 75-deg sharp leading-edge delta wing. Tests were conducted at a Mach number of 10.13, Reynolds number (based on model length) of 430,000, angles of attack of 15 and 19 deg, and zero sideslip angle. Abrupt pressure changes were observed in the flow field between the model surface and bow shock. Representative results are presented for alpha = 15 deg. Author (TAB)

N68-31870# Boeing Co., Philadelphia, Pa. Vertol Div.
TWO-DIMENSIONAL TESTS OF AIRFOILS OSCILLATING NEAR STALL. VOLUME 2: DATA REPORT Final Technical Report
Lewis Gray and Jann Liiva Apr. 1968 491 p ref
(Contract DA-44-177-AMS-438(T))
(D8-0678-2; USAAVLABS-TR-68-13B; AD-670958)

The report presents a discussion of the test facility, models, and data gathering and reduction system used in the tests of oscillating airfoils. It also contains the actual computer data that resulted from the wind tunnel tests of the airfoils. A set of tables provides a quick cross-reference between the various test factors and the page on which the data appear. Author (TAB)

N68-31990*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF THE LEADING-EDGE-SUCTION ANALOGY OF VORTEX LIFT TO THE DRAG DUE TO LIFT OF SHARP-EDGE DELTA WINGS
Edward C. Polhamus Washington Aug. 1968 14 p refs
(NASA-TN-D-4739) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A study has been made of the application of the leading-edge-suction analogy of vortex lift to the prediction of the drag due to lift on thin sharp-edge delta wings in incompressible flow. The study included comparisons with experimental results over a range of aspect ratios from 0.25 to 2.0. The results indicated that the drag due to lift can be predicted accurately by the zero-leading-edge-suction assumption, provided the vortex lift is accounted for by the leading-edge-suction-analogy method of NASA Technical Note D-3767. It was also found that because of the vortex lift, the drag due to lift for wings of extremely low aspect ratio can be less than that for optimum potential flow. Author

N68-32042# Martin Co., Baltimore, Md., Research Inst. for Advanced Studies.
REMARKS ON APPLIED SUBSONIC LIFTING SURFACE THEORY
Peter F. Jordan Aug. 1967 74 p refs

As a yardstick for lifting surface analysis (LSA) accuracy, reliable numerical results of the exact theory for the planar circular wing are presented. The pressure distribution is found to be composed predominantly of the first two Birnbaum–Glauert terms, even very close to the wing tips. In fact, it is found that LSA using the same two terms remains applicable at zero aspect ratio (AR), and will yield lift and moment exactly correct for the elliptic wing if two out of three available ideal pivot points are chosen. Correspondingly, the circular wing pressure distribution is calculated by LSA quite adequately even close to the wing tips. Convergence of LSA is determined by the errors due to the log component. The differences between the various proposed corrections for the first order term are usually negligible compared with the neglected higher order errors. The LSA diverges as the number of chordwise pivot points is increased. Author

N68-32180# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Physik der Atmosphaere.
KINEMATICS OF LEE-WAVES-FLOW. PART 2: TURBULENCE OF LEE-WAVES-FLOW [KINEMATIK DER LEEWELLENSTROEMUNG. TEIL 2: TURBULENZ DER LEEWELLENSTROEMUNG]

Walter Georgii Jul. 1968 29 p refs In GERMAN; ENGLISH summary
(DVL-758; DLR-FB-68-39) CFSTI: HC $3.00/MF $0.65

Turbulence as felt by a passenger of a commercial aircraft is produced by two mechanisms. Primarily exogeneous by the turbulence of the air-stream or endogeneous by change of the flightconditions produced heavy turbulence of the lee-waves-flow is observed in the rotors of the middle troposphere. This type of heavy turbulence is produced by the so-called water-fall, by wind-shear above $30 \cdot 10^{-3}$ sec^{-1} and in the tropopauserotors by parameter values with constant or increasing wind-velocity. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-30871# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
GENERAL METHOD OF CALCULATING THE FIELD OF RESOUNDING PRESSURE EMITTED BY STATIONARY AND MOBILE JETS [METHODE GENERALE DE CALCUL DU CHAMP DE PRESSION SONORE EMIS PAR LES JETS STATIONNAIRES ET MOBILES]
M. Kobrynski [1968] 12 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

A method is presented for calculating the maximal linear sound pressure spectra of stationary jets and jets in flight, and for determining the characteristics of the different zones of the entire acoustic field. The calculations are generalized to determine the sound pressure levels associated with different frequency bands, received on the ground at a fixed point, from various angles relative to the axis of the jet. The method was experimentally verified, and it is shown that the calculations make it possible to predetermine the levels of normalized auditory perception occurring at the time of the noise exposure. Transl. by M.G.J.

N68-30872 Societe Bertin et Cie, Plaisir (France).
STUDY OF AN ARRANGEMENT OF SIMULATION OF SONIC BOOM [ETUDE D'UN DISPOSITIF DE SIMULATION DE BANG SUPERSONIQUE]
Claude Doyotte [1968] 10 p In FRENCH Presented at Aeron. Acoust. Symp., Toulouse, 6-8 Mar. 1968

The problems involved in simulating the booms from supersonic aircraft are examined in terms of producing a signal of correct pressure, and accurately transmitting that signal. Electromagnetic and hydromechanic methods are discussed and the relative advantages of each are assessed. The production and transmission of low frequency sounds, which constitute the major part of the boom energy, is considered particularly important from the mechanical viewpoint. Transl. by M.G.J.

N68-30873 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
RELATIONSHIP BETWEEN PEAK VALUE AND SIGNAL DURATION OF PRESSURE IN N OF THE SONIC BOOM [RELATION ENTRE LA VALEUR DE CRETE ET LA DUREE DU SIGNAL DE PRESSION EN N DU "BANG" SONIQUE]
P. Lienard [1968] 6 p refs In FRENCH Presented at Aeron. Acoust. Symp., Toulouse, 6-8 Mar. 1968
CFSTI: $3.00

In considering the case of uniform rectilinear flight in an indefinite homogeneous atmosphere, Whitman equations are formulated to calculate the peak values of pressure and signal duration observed at a distance from the trajectory of a moving supersonic vehicle. Two corrections are introduced for above-ground calculations of flight in a stratified atmosphere. Experimental verification efforts are reviewed and it is reported that, although many different test results were obtained, good agreement was noted with the theoretical values. Transl. by M.G.J.

N68-30932 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
INFLUENCE OF REFLECTIONS ON THE SPECTRA OF ACOUSTIC PRESSURE OF JETS [INFLUENCE DES REFLEXIONS SUR LES SPECTRES DE PRESSION ACOUSTIQUE DES JETS]
R. Hoch and P. Thomas [1968] 32 p refs In FRENCH Presented at Aeron. Acoust. Symp., Toulouse, 6-8 Mar. 1968

An overview is presented on the problems associated with the phenomena of complex signal reflections and their effect on the acoustic pressure spectra of turbojet engines. Plots are included to depict the influence of ground cover conditions on the measurements. Details are given on a theoretical approach to the problem of sound reflections. The fundamental assumptions are defined, and equations are derived for the perturbations caused by the noise from its direct and reflected paths. Experiments were also conducted on jet models in a test chamber, and the acoustic measurements were analyzed by octaves in the frequency range of 200 to 40,000 Hz. Several examples are given to show the practical applications of the methods described. Transl. by M.G.J.

N68-30949 Societe Bertin et Cie, Plaisir (France).
EVOLUTION OF PROBLEMS OF NOISE REDUCTION IN JET AIRCRAFT [L'EVOLUTION DU PROBLEME DE REDUCTION DE BRUIT SUR AVIONS A REACTION]
Louis Duthion [1968] 11 p In FRENCH Presented at Aeron. Acoust. Symp., Toulouse, 6-8 Mar. 1968

Various methods of reducing aircraft noise are assessed, with consideration given to existing techniques for subsonic planes and the proposed engine designs for supersonic transports. The penalties in performance associated with the use of silencers are discussed, and figures are included to depict some configurations for deployable devices and convergent-divergent nozzles. The need for more advanced concepts and unconventional approaches in solving the problem is stressed. Transl. by M.G.J.

N68-30964# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
FEASIBILITY STUDY OF ADVANCED V/STOL PROPELLER TECHNOLOGY Final Report
W. M. Adamson Jun. 1968 385 p refs
(Contract DAAJ02-67-C-0073)
(USAAVLABS-TR-68-33; AD-671028)

A feasibility study of advanced V/STOL propeller systems for the 1970-1975 time period was conducted. The primary objective of the study was to investigate the application of new materials and new design concepts to define the maximum reductions in specific weight of the complete propeller system (including reduction gearbox) attainable in this time period. Preliminary designs of future propeller systems presented in the report are over 50 percent lighter than comparable present-day V/STOL systems. Three integral gearbox propeller systems, with and without cyclic pitch and with and without a cross-shaft drive pad, were defined in this report using the advanced technology indicated as feasible by the study. Each major component of the IGB propeller system was optimized and then merged into complete system designs. A

summary weight tabulation is presented showing the relative contributions of each major component of the propeller system to the total indicated weight reductions. A significant portion of the weight reductions is shown to be achievable by 1970, since the technology required is presently under development or is a natural extension of existing technology. Other significant weight reductions, such as those resulting from the use of boron blade spars and titanium gearing, are at an early phase of their technology development and are, at this time, not considered attainable much before 1975. Author (TAB)

N68-31032# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: AIRLIFT INTERNATIONAL, INC. DOUGLAS DC-7C, N2282 TACHIKAWA AIR BASE, TOKYO, JAPAN, SEPTEMBER 12, 1966
26 Feb. 1968 21 p
(PB-177339-1) CFSTI: HC $3.00/MF $0.65

The thesis investigates the solution of linear systems by extrapolated GAUSS—Seidel interation using a multiplicity of extrapolation parameters. This is a generalization of the method of successive over-relaxation, which uses a single scalar extrapolation parameter. The linear systems considered are those which arise in the numerical solution of boundary value problems for self-adjoint, elliptic partial differential equations. USGRDR

N68-31033# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: LAKE CENTRAL AIRLINES, INC. ALLISON PROPJET CONVAIR 340 N73130, NEAR MARSEILLES, OHIO, MARCH 5, 1967
26 Feb. 1968 35 p refs
(PB-177339) CFSTI: HC $3.00/MF $0.65

About 2007 e.s.t. on March 5, 1967, a Prop-Jet Convair 340 crashed near Marseilles, Ohio. The 38 persons aboard the aircraft received fatal injuries. The aircraft was destroyed. Investigation revealed that all four blades of the right propeller separated in flight and the No. 2 blade penetrated the aircraft fuselage in line with the propeller plane. The penetrations destroyed the structural integrity of the fuselage to an extent that, together with the loads caused by a right yaw which accompanied the propeller separation, the fuselage failed along the line of penetrations and the aircraft crashed. Author (USGRDR)

N68-31034# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: LEXINGTON AIR TAXI, INC. BEECH C-45H, N3727G NEAR BLUE GRASS FIELD LEXINGTON, KENTUCKY, APRIL 3, 1967
13 Mar. 1968 29 p refs
(PB-177339-2) CFSTI: HC $3.00/MF $0.65

The aircraft was observed after takeoff climbing slowly on runway heading in a nose-high altitude. At an altitude of between 200 and 300 feet the aircraft settled slightly, entered a left rotational spin, and crashed in an open field approximately 4,000 feet from the departure end of Runway 33. Witnesses reported seeing black smoke emanating from the underside of the aircraft just prior to impact. All nine persons on board, the pilot and eight passengers, received fatal injuries. The aircraft was destroyed by impact and subsequent fire. Author (USGRDR)

N68-31102# Human Engineering Labs., Aberdeen Proving Ground, Md.
ACOUSTICAL STUDY OF THE CH-47B (CHINOOK) HELICOPTER
Thomas S. Bragg Mar. 1968 83 p refs
(HEL-TN-4-68; AD-670971)

Sound measurements were conducted in the CH-47B (Chinook) Helicopter under conditions of normal cruise, maximum continuous power, level flight at various air speeds, hover, level acceleration and deceleration, and partial-power descent. Results are presented and compared with applicable parts of Military Specification MIL-A-8806 and U. S. Army Human Engineering Laboratories Standard S-1-63B. Variations of the noise from that specified in these documents are discussed, and it is recommended that the noise be reduced to conform to the specified levels. Author (TAB)

N68-31127# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
AN EXPERIMENTAL STUDY OF ALLEVIATING THE LIMITS ON MINIMUM-SPEED V/STOL WIND-TUNNEL TESTS
Shojiro Shindo and William H. Rae, Jr. Jan. 1968 27 p refs
(Grant DA-ARO(D)-31-124-G481)
(Rept.-68-1; AROD-4506-3-E; AD-671041)

An experimental study was made to investigate some means to alleviate flow breakdown by using a number of different strake or fence configurations. A total of 23 different configurations were studied in the 4 x 6 ft. insert with a 2 ft. diameter rigid rotor at about 7 psf disk loading. None of the strake configurations studied in the experiment completely eliminate the effect of flow breakdown. A further experimental investigation is desirable because of the increasing interest in testing V/STOL vehicles in the transition speed range. Author (TAB)

N68-31175# Denver Research Inst., Colo. Mechanics Div.
REDUCTION OF HAZARD FROM SECONDARY FRAGMENTS CREATED BY BALLISTIC PENETRATION OF AIRCRAFT
R. F. Recht and W. G. Howell Oct. 1967 94 p refs
(Contract DA-44-177-AMC-399(T))
(DRI-931-6702-F; USAAVLABS-TR-67-49; AD-665454)

The objective of the research effort was to establish a practical means of alleviating the hazard to personnel within occupied areas of Army aircraft due to secondary projectiles (spall and debris) created by ballistic impact of aircraft structure and equipment by small-arms projectiles. The characteristics of secondary fragments generated by ballistic penetration of typical aircraft structural materials were established for a variety of impact conditions which created the greatest hazard to personnel due to secondary fragments were used to evaluate suppressant systems designed to reduce or eliminate this hazard. A suppressant system was developed which proved to be capable of stopping virtually all secondary fragments generated by impact of structural materials tested. Author

N68-31204# Aeronautical Research Council (Gt. Brit.).
SOLUTION OF THE CATAPULT TAKE-OFF PERFORMANCE EQUATIONS BY AN ANALOGUE METHOD
E. W. Addicott and R. W. Jones 1968 34 p Supersedes RAE-TR-66026, ARC-28521; See N67-22705
(ARC-CP-977; PD-3681; RAE-TR-66026; ARC-28521; AD-833488) CFSTI: HC $3.00/MF $0.65

An analogue computer programme was derived, making as few approximations as possible, for the calculation of the flight path of an aircraft leaving the end of a ship-borne catapult. Using this complete calculation, it was shown that, for most aircraft, other approximations could be made without significantly impairing the accuracy of the result, and greatly simplifying the programme. A description of both programmes is given here, together with their derivation and method of use. Author (TAB)

N68-31205# Aeronautical Research Council (Gt. Brit.).
CABIN CONDITIONING TESTS ON A SIMULATED M2.2 TRANSPORT AIRCRAFT CABIN
T. L. Hughes and E. A. Timby 1968 130 p refs Supersedes RAE-TR-66118, ARC-29102; See N67-40253
(ARC-CP-976; PD-3680; RAE-TR-66118; ARC-29102; AD-833487) CFSTI: HC $3.00/MF $0.65

This paper describes tests made to investigate a cabin insulation scheme and to determine cooling air distribution requirements for a supersonic (M 2.2) passenger transport aircraft. Thermal conditions of flight were simulated in a ground rig with a section of aircraft fuselage equipped as a cabin. Several methods of introducing air into the cabin were tested. That employing the principle of jet entrainment was found to be the most economical in cooling air mass flow, to provide overall passenger thermal comfort. The insulation and cooling scheme for the cabin wall was evaluated and the amount of heat leakage in the test specimen established. Author (TAB)

N68-31546# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).

CHARACTERISTICS OF THE STRESS FREQUENCY DISTRIBUTION OF THE LOWER WING SURFACE OF THE BOEING 727 FROM FLIGHT MEASUREMENTS [KENNWERTE DES SPANNUNGSKOLLEKTIVS DER FLUEGELUNTERSEIT BOEING 727 AUS EICH- UND MESSFLUEGEN]

O. Buxbaum 1966 47 p refs In GERMAN
(FB-64(1966); JCAF-350) CFSTI: HC$3.00/MF$0.65

Vertical accelerations and lower spar boom stresses have been continuously recorded over 30 normal service flights and have been analyzed statistically. The absolute stress levels have been fixed by means of a flight calibration test. It is shown how the stress frequency distribution for a highly loaded area of lower in-spar-skin can be estimated from the results by means of extreme value distributions and the information on static tests supplied by the airplane manufacturer. Author

N68-31642# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: BRANIFF AIRWAYS, INC. BAC 1 11, N1553 NEAR FALLS CITY, NEBRASKA AUGUST 6, 1966

1968 78 p
(PB-177339-5) CFSTI: HC$3.00/MF$0.65

A Braniff Airways, Inc., BAC 1-11, N1553, operating as Flight 250, broke up in flight and crashed approximately 7.6 miles north-northeast of Falls City, Nebraska, at 2312 c.s.t., August 6, 1966. The 38 passengers and 4 crewmembers aboard the aircraft died in the accident and the aircraft was destroyed. Ground witnesses observed the aircraft flying into or over a roll cloud preceding a thunderstorm and shortly thereafter saw an explosion in the sky followed by a fireball falling out of the clouds. Two large pieces, later identified as major portions of the right wing and empennage, were seen falling separately from the main part of the aircraft. The flaming aircraft fell to the ground at approximately 2312 c.s.t. Shortly after the accident the ground witnesses noted high gusty surface winds and light to moderate rain which accompanied the passage of a squall line through the accident area. Author (USGRDR)

N68-31675# General Motors Research Labs., Warren, Mich.

STUDY OF THE POTENTIAL OF HOVAIR FOR HIGH SPEED GROUND TRANSPORTATION Final Report

Frederick Jindra Mar. 1968 131 p refs
(Contract C-197-66(Neg))
(PB-177523) CFSTI: HC$3.00/MF$0.65

The object of the program was to study the potential of the air bearings as a support system for high-speed ground vehicles. The tasks required included analytical investigations of performance characteristics of air bearings, analytical investigations of ride characteristics of vehicles with such support, development of dimensional analysis for experiments, and outlining future research and development requirements. Author (USGRDR)

N68-31740# National Transportation Safety Board, Washington, D. C.

FRONTIER AIRLINES, INC., DOUGLAS DC-3C, N65276, STAPLETON INTERNATIONAL AIRPORT, DENVER, COLORADO, DECEMBER 21, 1967

Joseph J. O'Connell, Jr., Oscar M. Laurel, John H. Reed, and Francis H. McAdams 20 Mar. 1968 18 p ref
(PB-177339-4) CFSTI: HC$3.00/MF$0.65

At 1600 m.s.t., December 21, 1967, Frontier Airlines cargo flight 2610, a DC-3C, N65276, crashed during takeoff from runway 35 at the Stapleton International Airport, Denver, Colorado. The captain and first officer, the only occupants of the aircraft, were killed. The aircraft was destroyed by impact and fire. Investigation revealed that the takeoff had been made with a control batten of gust lock in place on the right elevator. The Safety Board determines that the probable cause of this accident was the failure of the crew to perform a pre-takeoff control check resulting in takeoff with the elevators immobilized by a control batten. Author (USGRDR)

N68-31777# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

AIRCRAFT GROUND FLOTATION ANALYSIS PROCEDURES—PAVED AIRFIELDS Technical Report, Jan. 1963–Jan. 1967

Dale E. Creech and Donald H. Gray Apr. 1968 49 p refs
(SEG-TR-67-52; AD-670853)

The report describes standardized methods for analyzing ground flotation characteristics for aircraft of various designs based on the type of airfield construction. The method proposed for analyzing flexible pavements is an adaptation of the California Bearing Ratio (CBR) method. The analysis for rigid pavements is based on equations developed by Mr. H. M. Westergaard. The methods for overlay pavements are based on Air Force Manuals 88-24 and 88-6. The methods described were applied in an analysis of the KC-135 aircraft to illustrate the techniques. These methods can be applied to any aircraft to determine its flotation characteristics in relation to a given type runway. Author (TAB)

N68-31797# Vitro Labs., Silver Spring, Md.

LEAK DETECTION OF LARGE PRESSURIZED SPHERICAL BALLOONS Final Report, 1 Jul. 1967–30 Apr. 1968

Allen R. Davidson, Jr. 30 Apr. 1968 42 p
(Contract F19628-67-C-0414)
(TR-02091.01-1; AFCRL-68-0283; AD-670886)

The report summarizes an effort to locate and develop a leak detection system suitable for use on large pressurized balloons for the Air Force Cambridge Research Laboratories. A survey of various types of leak detectors and detection techniques was conducted to determine the most suitable method for detecting and locating leaks on pressurized spherical balloons 46 feet or more in diameter. As a result of the survey and appraisal testing, it was concluded that a thermal conductivity detector with a wide sweep wand could most readily detect and locate holes as small as 1/16 inch on large balloons filled with helium under an internal pressure of 1.5 inches of water. A leak detection system was designed and built, utilizing a modified commercially available thermal conductivity leak detector. Author (TAB)

N68-31807# Aeronautical Research Labs., Melbourne (Australia).

LOW SPEED WIND TUNNEL TESTS TO INVESTIGATE POWER PLANT INTAKE PERFORMANCE AND STATIC LONGITUDINAL CHARACTERISTICS OF THE G.A.F. PROJECT F2

K. A. O'Dwyer Jun. 1967 60 p ref
(ARL/AERO-289) CFSTI: HC$3.00/MF$0.65

A preliminary investigation of a jet trainer project of the Government Aircraft Factories has been made in the 8'x7' low

speed wind tunnel. The performance of the engine and fan ducts and some longitudinal force and moment characteristics were obtained from measurements made using a 1/6th scale model of the original configuration (designated F2-1). Also some preliminary characteristics of the fan duct of the changed aircraft configuration (designated F2-2) were obtained from measurements using a half duct model fitted to the original F2-1 model. Author

N68-31854# Aviation Safety Engineering and Research, Phoenix, Ariz.

CRASH SURVIVAL DESIGN GUIDE

J. W. Turnbow, D. F. Carroll, J. L. Haley, Jr., W. H. Reed, S. H. Robertson et al Dec. 1967 271 p refs Revised

(Contract DA-44-177-AMC-360(T))

(AvSER-66-18; USAAVLABS-TR-67-22; AD-670955)

The report is a Design Guide which was assembled to provide the engineer with an understanding of the basic problems associated with the development of crashworthy U. S. Army aircraft. Where possible, solutions to specific problems are indicated. In other areas, in which little design data are available, only the general philosophy appropriate to the problem solution is presented; the details of such solutions as well as the degree of crashworthiness to be achieved must be left, at present, to the ingenuity of the designer. This guide presents in a condensed form the data, design techniques, and criteria which are presently available in eight areas: (1) Aircraft Crash Kinematic and Survival Envelopes, (2) Airframe Crashworthiness Design Criteria, (3) Aircraft Seat Design Criteria (Crew and Troop/Passenger), (4) Restraint System Design Criteria (Crew, Troop/Passenger and Cargo), (5) Occupant Environment Design Criteria, (6) Aircraft Ancillary Equipment Stowage Design Criteria, (7) Emergency Escape Provisions, and (8) Postcrash Fire Design Criteria. Both airframe and component designers and manufacturers should use this guide to extend the region of survivability in aircraft accidents to a maximum level. Author (TAB)

N68-31862# LTV Aerospace Corp., Dallas, Tex. Vought Aeronautics Div.

DYNAMIC RESPONSE OF THE XC-142A TILT-WING V/STOL AIRCRAFT TO IN-FLIGHT CARGO DELIVERY AT SLOW SPEEDS Final Report

Jerry W. Wilson, Mike P. Schira, and J. Steve Deitering Mar. 1968 123 p refs

(Contract DA-44-177-AMC-327(T))

(Rept.-2-53310/GR-6098; USAAVLABS-TR-68-4; AD-670965)

The potential ability of V/STOL aircraft to perform Army drop missions at various altitudes while flying at speeds from hover to conventional flight could provide a basis for precision in-flight delivery and could overcome major operational restrictions associated with many of the conventional air-drop techniques. The study was partially based on actual air-drop demonstrations. Single cargo loads of up to 3,000 pounds were gravity dropped in hover and at 30 knots, and loads of up to 4,000 pounds were extracted by parachute at 127 knots. Using these flight data to set up a realistic simulation, a mathematical model of the XC-142A airplane and a human pilot were used to examine the aircrafts response with cargo weights up to the airplanes maximum payload of 8,000 pounds in the low-speed portion of transition and 12,000 pounds at a 127-knot flight condition. The study shows that the maximum payload could be successfully dropped with proper pilot technique. Means of extending the airplanes air-drop capability through the use of special extraction forces and parameters applicable to the air-drop system were studied. Author (TAB)

N68-31867# Kaman Aircraft Corp., Bloomfield, Conn.

FLIGHT RESEARCH PROGRAM TO EVALUATE METHODS OF IMPROVING COMPOUND HELICOPTER MANEUVER CAPABILITY Final Report

W. E. Blackburn and A. D. Rita Apr. 1968 37 p refs

(Contract DA-44-177-AMC-151(T))

(R-622A; USAAVLABS-TR-67-59; AD-670942)

The results of a flight research program conducted to investigate methods of improving maneuvering capability of the UH-2 compound helicopter are presented. The effects of wing/rotor load sharing were determined during symmetrical pullup maneuvers using preselected longitudinal cyclic inputs. The wing/rotor load sharing ratio was varied by automatically reducing collective pitch as a function of normal load factor. This was found to increase the attainable maximum normal load factor by 78 percent. Automatic reduction of collective pitch also reduced longitudinal cyclic control sensitivity during maneuvering flight. Roll control augmentation using ailerons was found to be one satisfactory method for imparting acceptable handling qualities for lateral/directional maneuvers in compound aircraft. Author (TAB)

N68-31931# National Transportation Safety Board, Washington, D. C. Bureau of Aviation Safety.

BRIEF OF ACCIDENTS, 1967, NO. 4: U.S. CIVIL AVIATION

1968 199 p

(PB-177340-4)

The publication contains reports on accidents processed during the month of September 1967. The cause factor, accident types, operational phases, and kinds of flying, contained in this report have been tabulated. Collisions between aircraft are treated as one accident. A complete analysis and coding is done on each aircraft involved in collisions. This produces two aircraft accident records, one for each aircraft involved in the collisions. Consequently, when compiling information on accidents involving collisions between aircraft, the number of accident records will exceed the number of accidents. The injury tables show the number of accidents. All other statistical tables show the number of accidents records. Author (USGRDR)

N68-31932# National Transportation Safety Board, Washington, D. C.

AIRCRAFT ACCIDENT REPORT: WEST COAST AIRLINES, INC., FAIRCHILD F-27, N2712, NEAR KLAMATH FALLS, OREGON, MARCH 10, 1967

6 Mar. 1968 34 p

(PB-177339-3) CFSTI: HC$3.00/MF$0.65

At 0503 P.s.t. on March 10, 1967, a Fairchild F-27, operating as Flight 720, crashed 4.1 miles southeast of Kingsley Field, Klamath Falls, Oregon, at a terrain elevation of about 5,049 feet. The aircraft struck the northwest face of Stukel Mountain (elevation 6,525 feet) two minutes after takeoff and was demolished by impact. One revenue passenger and three crewmembers were aboard and all sustained fatal injuries. Author (USGRDR)

N68-31956*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

EXPERIMENTAL VERIFICATION OF SCALE FACTORS FOR PARAWING OPENING CHARACTERISTICS

David L. Eichblatt, Robert H. Moore, and Richard L. Barton Washington Aug. 1968 30 p refs

(NASA-TN-D-4665) CFSTI: HC$3.00/MF$0.65 CSCL 01C

The verification of an analytical scaling technique by experimental drop tests under controlled conditions is presented in which the opening characteristics of a full-scale flexible parawing are predicted from the results of model testing. The scaling method is derived from a comparison of similar forces (in the equation of motion) on a scale model with a keel length of 4 feet and a full scale of 8 feet. Initial velocities of 17 to 40 feet per second were used in the test program. Test results within the scope of the program indicate that the models can be used to predict full-scale deployment characteristics. Author

N68-32044*# Serendipity Associates, Los Angeles, Calif.
STUDY OF FLIGHT MANAGEMENT REQUIREMENTS DURING SST LOW VISIBILITY APPROACH AND LANDING OPERATIONS. VOLUME 1: DEFINITION OF BASELINE SST LANDING SYSTEM
Richard E. Shoemaker, Walter B. Gartner, William J. Ereneta, and Vincent R. Donohue Oct. 1967 107 p refs
(Contract NAS2-4406)
(NASA-CR-73240; TR-56-67-12(U), V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Flight management functions during approach and landing of supersonic transport (SST) during low visibility are considered, and the baseline is established for the low visibility landing system anticipated for the United States' SST. This baseline system assumes an ILS-type signal source on the ground and redundant automatic control systems in the aircraft. Runway imaging systems and heads up displays were not included. Flight management functions are defined and broken down into special types. Requirements for flight management and support provided to the crew are described along with equipment activities. Author

N68-32045*# Serendipity Associates, Los Angeles, Calif.
STUDY OF FLIGHT MANAGEMENT REQUIREMENTS DURING SST LOW VISIBILITY APPROACH AND LANDING OPERATIONS. VOLUME 2: DELINEATION OF POTENTIAL PROBLEMS IN SUPPORTING THE PERFORMANCE OF FLIGHT MANAGEMENT TASKS
Walter B. Gartner and Richard E. Shoemaker Jan. 1968 74 p refs
(Contract NAS2-4406)
(NASA-CR-73241; TR-56-68-1(U), V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Potential flight management problems which might arise during low visibility landings in the projected United States supersonic transport (SST). Flight management tasks required during critical phases of the approach and landing which were determined to place high cognitive demands on SST command pilots are delineated along with potential human engineering and pilot acceptance problems. Many of the problems derived in the analysis are directly related to the projected airborne landing system configuration. Others stem from assumptions regarding operational procedures, environmental conditions, and characteristics of ground based components of the SST low visibility landing system. Most problems were found during the later phases of the approach and landing due to the decrease in time available and allowable margin for error. Significant potential problems were identified in: (1) judging the success of the approach; (2) resolving the landing commitment decision; (3) assessing initiation and execution of the landing maneuver; (4) initiation and execution of the go-around mansuver; and (5) assessing equipment operating status and resolving override, reconfiguration, and disengagement decisions. Author

N68-32046*# Serendipity Associates, Los Angeles, Calif.
STUDY OF FLIGHT MANAGEMENT REQUIREMENTS DURING SST LOW VISIBILITY APPROACH AND LANDING OPERATIONS. VOLUME 3: RECOMMENDATIONS FOR A SIMULATION RESEARCH STUDY OF SELECTED FLIGHT MANAGEMENT SUPPORT PROBLEMS
Walter B. Gartner and Richard E. Shoemaker Jun. 1968 60 p refs
(Contract NAS2-4406)
(NASA-CR-73242; TR-56-68-8(U), V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Simulation study objectives, general approach, and requirements are described for selected supersonic transport (SST) approach and landing flight management problems to be investigated in a piloted flight simulator. Details are presented for the experimental plan for conducting these studies. Controlled variations in flight profiles and environmental conditions are included for the simulated approach and landing flight sequence; and experimental tasks, subject selection and task orientation, and experimental design are discussed. Simulation of the SST information availability and display characteristics, as well as simulation of the automatic flight path and airspeed control are reported. M.W.R.

N68-32047*# Serendipity Associates, Los Angeles, Calif.
STUDY OF FLIGHT MANAGEMENT REQUIREMENTS DURING SST LOW VISIBILITY APPROACH AND LANDING OPERATIONS Final Summary Report
Walter B. Gartner and Richard E. Shoemaker Jun. 1968 64 p refs
(Contract NAS2-4406)
(NASA-CR-73243; TR-56-68-9(U)) CFSTI: HC $3.00/MF $0.65 CSCL 01B

An overview is presented of the analytic procedure used in the analysis of flight management task requirements for approach and landing of a supersonic transport (SST). The baseline SST low visibility landing system is described briefly, and the analysis of cognitive task loading is summarized. Potential problems in supporting the performance of these flight management tasks were identified; and details are included for problems related to (1) judging the approach; (2) resolving the landing commitment decision; (3) assessing initiation and execution of landing maneuver and the go-around or landing abort maneuver; and (4) resolving override, reconfiguration, and/or disengagement decisions. Recommendations are included for a simulator study of selected flight management support problems, including the study objectives and plans. M.W.R.

N68-32065# Brussels Univ. (Belgium).
AN EXPERIMENTAL AIR-CUSHION VEHICLE PV1 [VEHICULE EXPERIMENTAL A COUSSIN D'AIR PV-1 RAPPORT DE SYNTHESE] Summary Report
A. Jaumotte, A. Kiedrzynski, and M. Lejeune 1967 14 p refs
(Contract DRME-65-34079-00-480-75-01)
(DRME-79-65; NT-15-1967; Rept.-7; ESRO-345)

Characteristics and capabilities of ground effect machine, the experimental air cushion vehicle PV-1 (Platte-forme Volante-1) are described. Utilizing the peripheral jet principle, the vehicle was constructed to study air cushion aerodynamics, stability, propulsion, behavior in free flight, and flight over water. Problems created by flaps are discussed, and stability in both pitching and rolling motions is considered. Control and piloting techniques for the vehicle are reported. Transl. by M.W.R.

N68-32123# Brussels Univ. (Belgium). Institute of Applied Mechanics.
EXPERIMENTAL GROUND EFFECT MACHINE PV-1. STUDIES IN FLIGHT ON THE WATER
A. Jaumotte, A. Kiedrzynski, M. Lejeune, and G. Van de Steen 1967 23 p refs In FRENCH
(Contract DRME-65-34079-00-480-75-01)
(DRME-79-65; NT-13-1967; Rept.-6; ESRO-344) CFSTI: HC $3.00/MF $0.65

Data are presented on the performance of an experimental ground effects machine during static tests in a water basin at low speeds, and towing tests up to speeds on the order of 30 km/h. Transl. by M.G.J.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also 09 Electronic Equipment, 22 Nuclear Engineering, and 28 Propulsion Systems.

N68-30961# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
ON-BOARD POWER SUPPLY FOR SOUNDING ROCKETS [ALIMENTATION GENERALE DE BORD POUR FUSEES SONDES]
Alain Simon Mar. 1967 28 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Characteristics of space-borne batteries are analyzed. Zinc-silver and cadmium–nickel batteries are discussed as well as switching devices. A description is given of a standard set including telemetry, remote control, radar transponder and sequential programs, developed for the CNES. ESRO

N68-31018*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLAT PLATE THERMOELECTRIC GENERATORS FOR SOLAR PROBE MISSIONS
Valvo Raag, Robert E. Berlin, and William J. Bifano Washington 1968 12 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-52451) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The design of a flat-plate thermoelectric generator for operation at 0.25 AU or less from the sun is presented. Design output is 150 watts at 28 volts. Generator electrical performance, temperature profiles, and component weights are included. Layout drawings illustrate the generator configuration. The operations of the generator under a variety of off-design conditions, in terms of variable absorptance and emittance characteristics of generator surfaces and its operating distance from the sun, is discussed. Author

N68-31042*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF A 1200-HERTZ ALTERNATOR AND CONTROLS FOR SPACE POWER SYSTEMS
B. D. Ingle and C. S. Corcoran 1968 14 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-52453) CFSTI: HC $3.00/MF $0.65 CSCL 10B

For a 1200-hertz Brayton energy conversion system having a useful load rating of 10 kWe, an alternator and the associated voltage and frequency controls were designed and tested. The unique features in the components are: (1) the 36,000-rpm solid-rotor alternator designed to accommodate gas bearings; (2) pulse-type voltage regulator which is synchronized with the line frequency; and (3) multiple parasitic-loading speed control. Author

N68-31062*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BRAYTON CYCLE ALTERNATOR-DRIVE TURBINE AERODYNAMIC STUDY
M. G. Kofskey, W. J. Nusbaum, and W. L. Stewart Washington 1968 12 p refs Presented at the IEEE Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 14–16 Aug. 1968
(NASA-TM-X-52430) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The principal results obtained from the study of a two-stage turbine indicated a satisfactory level of efficiency, a small Reynolds number effect, and a rather large rotor-tip-clearance effect. When applying these results to a two-shaft Brayton power system, it was found that the turbine system efficiency was actually one point higher than that designed for and did not vary significantly during operation over a wide range of pressure level and, consequently, power output. Author

N68-31068*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHODS FOR FABRICATING CdS THIN-FILM SOLAR CELL MODULES
A. F. Ratajczak, F. A. Blake (GE, Philadelphia), and M. R. Stahler (GE, Philadelphia) Washington 1968 13 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-52458) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Two methods for the series and parallel interconnection of CdS thin film solar cells into modules have been developed and evaluated. Either soldered or conductive-epoxy bonding methods can be used with either of two electrical paralleling methods to produce modules having low joint resistivity, low weight, high mechanical strength, and maximum area utilization. Sample submodules of each method have exceeded the requirements of specialized dynamic, tensile, and vacuum thermal cycling tests. Processes and tooling have been developed and used for the efficient fabrication of both soldered and bonded modules of 25 cells each. The soldered modules weigh 0.3447 kg/m^2 and the bonded modules weigh 0.3055 kg/m^2. A solder type joint for interconnecting modules was also devised. It affords easy module replacement and incorporates the same principle of stress-free electrical connection used to connect cells in the soldered module. Author

N68-31091# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
ATTITUDE CONTROL SYSTEMS FOR SOUNDING ROCKETS [LES SYSTEMES DE CONTROLE D'ATTITUDE POUR FUSEES-SONDES]
C. Poher 15 Mar. 1967 8 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

An attitude control system for sounding rockets developed jointly by CNES and O.N.E.R.A. is described. This system is called CASSIOPEE. ESRO

N68-31094*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEPING FLOW SOLUTION OF LEIDENFROST BOILING WITH A MOVING SURFACE
Kenneth J. Baumeister and Glen J. Schoessow Washington 1968 22 p refs Presented at the 10th Natl. Heat Transfer Conf. sponsored by the Am. Inst. of Chem. Engr. and the ASME, Philadelphia, 11–14 Aug. 1968
(NASA-TM-X-52443) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The total vaporization time of water drops in Leidenfrost boiling with supporting plate velocities up to 15 ft/sec has been correlated with a standard deviation of 4.5 percent. The analytical model combines stagnation and Couette flow profiles. In this paper, the vaporization time for a drop film boiling on a moving surface is related to the equivalent vaporization time for a smaller drop placed on a stationary surface. Author

N68-31095*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF THE CADMIUM SULFIDE THIN-FILM SOLAR CELL
F. A. Shirland (Clevite Corp., Cleveland), A. F. Forestieri, and A. E. Spakowski Washington 1968 7 p refs Presented at IEEE Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 14–16 Aug. 1968
(NASA-TM-X-52436) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The CdS thin-film solar cell has major advantages for space power applications because of its large size, lightweight, flexibility, radiation resistance and low cost potential. The cells are not yet acceptable, however, because of degradation and instabilities incurred under thermal cycling at simulated space conditions. A brief description is given of the design of the cadmium sulfide thin-film solar cell as it has evolved to date for space applications. The performance levels achieved are summarized along with the degree of reproducibility and yields obtained on pilot production in recent months. Improvments in design and performance presently being

investigated are also discussed. A summary of the results of testing of cadmium sulfide thin-film solar cells is presented. These include cells subjected to the following conditions: wet shelf storage, dry shelf storage, vacuum thermal storage, and vacuum thermal cycling. Author

N68-31096*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
2 TO 10 KILOWATT SOLAR OR RADIOISOTOPE BRAYTON POWER SYSTEM
John L. Klann Washington 1968 14 p refs Presented at the IEEE Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 14–16 Aug. 1968
(NASA-TM-X-52438) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A second generation Brayton power system has been defined. Hardware components are currently being assembled for complete, ground-based power system tests. The power systems to be tested are described. Maximum system efficiency is estimated at 0.19 for two kilowatts of output, rising to about 0.27 in the range from six to ten kilowatts. Author

N68-31116*# Bendix Corp., Southfield, Mich. Research Labs.
FABRICATION AND TEST OF A FLUERIC POSITION SERVO Final Report
M. H. Cardon and R. H. McFall 15 Aug. 1968 66 p
(Contract NAS3-6201)
(NASA-CR-72423; BRL-4475) CFSTI: HC $3.00/MF $0.65 CSCL 13G

A flueric position servo has been designed to position a control drum of a nuclear rocket engine. The flueric amplifier of the servo, which is implemented with vortex elements, was evaluated experimentally. The system uses a piston-cylinder with a rack and pinion that produces 180 degrees rotary output. The system is designed to have a 6 hertz bandwidth, 0.2 degree of resolution, and 300 in-lb stall torque. The supply pressure is 215 psia and the exhaust pressure is 50 psia. This report describes the system and presents the results of the experimental evaluation performed on the components. Author

N68-31163*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATING CHARACTERISTICS OF A LIQUID-COOLED CONTAINED ELECTROLYTE LOW TEMPERATURE FUEL CELL SYSTEM OVER A PERIOD OF 1500 HOURS
J. M. McKee, N. H. Hegedorn, and R. W. Easter Washington 1968 11 p Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-52455) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A 1500-hour performance investigation was conducted on a 2 kW liquid-cooled contained-electrolyte low-temperature (≈165°F) fuel cell system. Average cell potential loss at the 2kW level was 31 microvolts per hour. Short-term overloads to 3.5 kW had no permanent effect on subsequent performance, and there was no apparent change over the test duration in the system's ability to handle brief overloads. Bootstrap restart capability at room temperature was demonstrated. After 1500 hours on load the fuel cell stack was flushed with fresh electrolyte and put back on test for 50 hours. Performance approached the highest level obtained when the stack was new, indicating that the degradation was not a result of any substantial change in the electrochemical characteristics of the cells. Performance instabilities encountered were primarily attributed to malfunction of systems components and/or corrosion of materials by the electrolyte. Author

N68-31262# Siemens-Schuckertwerke A. G., Erlangen (West Germany).
PROGRESSIVE DEVELOPMENT OF N–P SILICON SOLAR CELLS, WITH PARTICULAR REFERENCE TO THE USABILITY OF SILICON WEBS [WEITERENTWICKLUNG VON N/P-SILIQIUM-SOLARZELLEN, BESONDERS IM HINBLICK AUF DIE VERWENDUNG VON SILIZIUM-WEBS]
T. Renner and A. Mueller Bundesministerium fuer Wiss. Forsch. Apr. 1968 127 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-28) CFSTI: HC $3.00/MF $0.65

The first part deals with a procedure for pulling silicon webs and describes crystallographic properties of web crystals. A process for making n-on-p solar cells is presented and applied to silicon cut from bulk material and to web material. Such special problems as anti-reflex etching and solar cell measurements are discussed. The electrical data show that the efficiencies of web cells approach those of conventional cells. From a technological point of view web cells exhibit obvious disadvantages compared with cells made of bulk material. Author

N68-31290# Naval Research Lab., Washington, D. C.
A DC TO DC CONVERTER WITH CONSTANT OUTPUT VOLTAGE Final Report
Joseph M. Marzolf 7 May 1968 8 p
(NRL-6714; AD-671051)

A simple dc-to-dc inverter circuit was developed which provides a constant average dc voltage output for wide ranges of input voltage. This circuit was designed to demonstrate the basic principles involved, and no attempt was made to maximize the efficiency, which undoubtedly could be improved considerably. The basic requirements that must be incorporated in this circuit are (a) each half-cycle must be triggered at a constant frequency, (b) the time duration of each half-cycle must be less than the time between successive triggering half-cycles, (c) the power transistors must be cut off when the power core saturates, and (d) turn-off of one half-cycle must not spontaneously initiate the succeeding half-cycle. An inverter circuit operating on these principles would provide a relatively simple method of providing a dc-to-dc converter having a constant voltage output, regardless of variations in input voltage or load, over relatively large ranges. Since it is based on switching techniques, its efficiency is high over its full operating range. Author (TAB)

N68-31291# Naval Research Lab., Washington, D. C.
CRYSTALLOGRAPHIC CHANGES DURING OXIDATION (CHARGING) OF THE SILVER ELECTRODE. PART 1: INITIAL OXIDATION OF AN INDUSTRIAL SINTERED PLAQUE Interim Report
C. P. Wales and A. C. Simon 3 May 1968 28 p refs
(NRL-6701; AD-671050)

The Ag electrode was studied during oxidation using the optical microscope. As a preliminary to other, more detailed experiments, the oxidation during the first charge of an unused sintered Ag plaque was observed as Ag was converted first to Ag2O and then to AgO. The initial oxidation occurred on the smaller particles of Ag, and these were usually completely oxidized by the end of charge, whereas the larger Ag particles were left largely unconverted. The rate of reaction was quite unequal in different areas of the electrode. AgO crystals were larger than Ag2O crystals and may have blocked the surface in some areas. Both particle size of Ag and the formation of dense layers of AgO may have limited complete oxidation and may partially have been responsible for the inability of the electrode to produce the full capacity that was theoretically possible. Author (TAB)

N68-31340*# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES Semiannual Report, 1 Sep. 1967–29 Feb. 1968
Robert D. Walker, Jr. 24 May 1968 68 p refs
(Grant NGR-10-005-022)
(NASA-CR-95957; SAR-5) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Studies focusing on: (1) the development of a theoretical treatment of solubility; (2) measurements of the vapor pressure of LiOH solutions; (3) measurements of gas solubilities on LiOH solutions; and (4) measurements of gas diffusivities in KOH solutions; are reported. Author

N68-31373*# General Electric Co., Schenectady, N. Y. Research and Development Center.
REDUCED GRAVITY BATTERY TEST PROGRAM Quarterly Report, Feb. 21–May 20, 1968
A. J. Yerman et al Jul. 1968 82 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952121)
(NASA-CR-95993; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Details are given on the design, construction, and testing of a breadboard model of test equipment capable of investigating the behavior of secondary Ag–Zn batteries in the zero-g environment of an earth orbit. The basic experimental work carried out to define the test procedures and equipment requirements is discussed, together with the control circuits to be used for programming the test sequence, and recommendations covering an instrumentation tape recorder which is to be a part of the breadboard unit. The experimental work includes the results obtained with a current ramp generator which is proposed as a convenient way of obtaining polarization data on cell electrodes, and data obtained from tests of a commercial Ag–Zn battery which was selected as a representative test specimen for one of the space experiments. A basic approach to the control and programming of the experiments based on the use of available digital integrated circuits is described. Also, results are presented covering a survey of instrumentation tape recorders for the application, and recommendations of specific instruments are made. Author

N68-31381# Royal Aircraft Establishment, Farnborough (England).
A SOLAR CELL AND HEATER SYSTEM TO REDUCE THE TEMPERATURE VARIATION OF UNITS IN A SPACECRAFT
E. C. Semple Nov. 1967 13 p
(RAE-TR-67277; AD-669854)

A simple semi-active system is described which will improve the thermal performance of some spacecraft employing an otherwise passive system of thermal control. This involves the use of a small array of solar cells to provide power to a resistor in a unit which may otherwise run too cold in some attitudes. Author (TAB)

N68-31391*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS
P. Payne 15 Jul. 1968 14 p Prepared for JPL
(Contract NAS7-100; JPL-952247)
(NASA-CR-96012; Rept.-3; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Various parameters of the lithium diffusion were investigated with respect to uniformity of the cell electrical characteristics. A new lithium furnace was set up. Lithium diffusions were done in a helium atmosphere and compared to those done in a nitrogen atmosphere. Cell position on the diffusion boat during lithium diffusion was investigated with respect to cell electrical characteristics. Study of the effect of boron diffusion process parameters on lithium cell electrical characteristics was also started. Two shipments of sixty cells each have been fabricated and the first has been submitted to JPL for radiation testing. Yield analyses has started and will be done for each shipment of cells. This analysis is expected to be a valuable tool in analyzing progress with respect to process control and in selecting optimum parameters. Author

N68-31407*# Thermo Electron Engineering Corp., Waltham, Mass.
SOLAR ENERGY THERMIONIC (SET) PROGRAM Final Report, Task 1
P. G. Pantazelos, S. Merra, P. Brosens, and B. Gunther Mar. 1968 276 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950671)
(NASA-CR-96013; TE-4034-73-67) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Thermionic converters incorporating rhenium emitters were designed to emphasize power output and mechanical ease of attachment to the solar thermionic generator structure. Three prototype converters were designed; and the third, which used a pressure bonded emitter, was used in the generator. Generator support structure shielding and electron bombardment heater were designed and constructed concurrently with the converter development program. Because the converter was designed to achieve maximum power output at 0.7 volt, a large heavy radiator was required to reject the necessary heat. Since generator calculations indicated optimum efficiency at 0.9 volt, this diode voltage was optimized in radiator design. A thin radiation shield between radiator and reservoir improved cesium reservoir temperature distribution. A four-converter generator, JG-3, was designed with thermal shielding between the diodes and the generator blocks. The final electron-bombardment gun design had individual filaments for each of the diodes. M.W.R.

N68-31409*# Ion Physics Corp., Burlington, Mass.
IMPROVED SOLAR CELL CONTACTING TECHNIQUES Quarterly Report
R. W. Sudbury and K. A. Stirrup Apr. 1968 14 p Prepared for JPL
(Contracts NAS7-100; JPL-952144)
(NASA-CR-95998; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Work is reported on aluminum and nickel contacted solar cells using high vacuum sputtering technology. Cells were fabricated with both aluminum and nickel contacts, and electrical measurements made. The effect of a temperature cycle after sputtering is reported for aluminum contacted solar cells. Aluminum contacted cells with greater than 10% AMO efficiency are reported for an uncoverslipped CeO_2 antireflected coated cell. Author

N68-31411*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Flight Research Dept.
A STUDY OF TWO PROPOSED STABILIZATION TECHNIQUES FOR THE X-15 HORIZONTAL SURFACE CONTROL SYSTEM
William R. Deazley 10 Aug. 1961 84 p refs
(Contract NAS4-123)
(NASA-CR-95955; CAL-TB-1566-F-1) CFSTI: HC $3.00/MF $0.65 CSCL 01D

An analysis is presented of two proposed methods for providing additional gain margin in the stability augmentation loop of the X-15 horizontal surface control system. Expansion of the flight envelope to higher dynamic pressures, Mach numbers and altitudes has made it imperative to introduce refinements in the basic control system. The two methods considered in this report are the "notch filter" and "hydraulic pressure feedback" techniques. Both methods have considerable merit, but the pressure feedback approach appears to offer the most improvement. Author

N68-31473*# Metals and Controls Inc., Attleboro, Mass. Metallurgical Materials Div.
HEAT STERILIZABLE Ni–Cd BATTERY DEVELOPMENT Quarterly Report, 1 Jan.–31 Mar. 1968
P. V. Popat 31 Mar. 1968 38 p Prepared for JPL
(Contracts NAS7-100; JPL-951972)
(NASA-CR-96011; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The work performed to date has established the technical feasibility of heat-sterilization of sealed nickel-cadmium cells. They maintain approximately 75% of the nominal capacity after

heat-sterilization in fully discharged condition. The major problem areas identified and on which work is now being done are (1) changes in the oxygen-free capacity and morphology or crystal structure of the positive plate (2) oxidation of excess cadmium metal in the negative plate and (3) changes in the electrolyte absorption and distribution during heat-sterilization. Electrochemical performance data for automatic continuous cycling of sealed control cells containing the two best available heat-sterilizable separators and various levels of electrolyte are presented. There is little change in the performance of these cells as a function of cycling. The delivered capacity increases as the rate of charge increases, other conditions being the same. Optimum electrolyte level appears to be between 70 and 80% of the free pore volume. Author

N68-31488*# Electro-Optical Systems, Inc., Pasadena, Calif.
THERMIONIC RESEARCH AND DEVELOPMENT PROGRAM Quarterly Progress Report
D. L. Jacobson, R. Hamerdinger, and A. Campbell 12 Jul. 1968 71 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952217)
(NASA-CR-95979; EOS-4006-Q-1; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Single crystal molybdenum and rhenium electrodes were considered for yielding a low work function collector surface in thermionic converters. Vacuum emission vehicle determinations of the effective and Richardson work functions were made, and electrode surfaces using a thermionic emission microscope were examined. Both X-ray and metallographic analyses were made, and a vapor-deposited rhenium variable parameter test vehicle was considered for studying minimum work function and optimized power output of these same electrodes. Converter design and thermal mockups are described for a 1700° to 1800°K cylinder converter; and details are included of the emitter subassembly, emitter support structure, collector-radiator structure, prefabricated metal-to-ceramic seals, and cesium reservoir. M.W.R.

N68-31490*# Thermo Electron Engineering Corp., Waltham, Mass.
SOLAR THERMIONIC GENERATOR DEVELOPMENT Quarterly Report, 1 Mar.–31 May 1968
May 1968 32 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951263)
(NASA-CR-95980; TE4055-176-68; QR-10) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The fabrication and test of converter T-209 were completed. This model was the second to incorporate a collector-radiator heat pipe structure. The heat pipe design was changed substantially in order to remedy a choked heat pipe vapor flow condition observed in the previous model T-208, and subsequent tests showed that this objective was reached. Converter T-209 equalled the highest output observed from any of the rhenium-emitter and rhenium-collector converters fabricated; however, during tests at high heat inputs, the output was found to deteriorate. This was the first instance of degradation experienced, and it appears that it was caused by a leak of sodium vapor from the heat pipe into the converter envelope, which resulted in an increase of the collector work function of 0.17 eV. The mechanism responsible for the sodium leak is not known. The layout of the 16-converter generator was completed, and the design is now ready for the preparation of detailed drawings. Author

N68-31492*# Thermo Electron Engineering Corp., Waltham, Mass.
APPLIED THERMIONIC RESEARCH Quarterly Progress Report, 4 Mar.–4 Jun. 1968
E. P. Gyftopoulos, G. N. Hatsopoulos, F. Holly, D. Lieb, F. Rufeh et al 4 Jun. 1968 76 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952184)
(NASA-CR-95987; TE4092/3-183-68; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Thermochemical data on the oxidation products of cesium studied by differential thermal analysis indicated a rather complex mixture and observed peaks that could be attributable to Cs_2O, CsOH, and Cs_2O_2. Rigorous definitions were given of the electronegativity of neutral and ionized atoms and of atomic orbitals that are consistent with the rules of the statistics of the ensembles and the quantum mechanical picture of atomic species. Dependence of the internal voltage drop on ion richness (β) and cesium pressure (P) at constant values of Pd, where d is the interelectrode spacing were made with a variable-spacing, guard-ring converter with single tungsten emitter and molybdenum collector. It is suggested that voltage drop is a decreasing function of P at constant values of Pd and β, and a decreasing function of β at constant values of P and d. To obtain data on in-pile test converters, a variable-spacing, guard-ring converter with fluoride vapor-deposited tungsten emitter and molybdenum collector was constructed. Heat treatment caused changes in microstructure, not necessarily accompanied by pole figure changes, of the vapor-deposited tungsten emitters. M.W.R.

N68-31518*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.
HEAT STERILIZABLE, IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Jan.–31 Mar. 1968
G. W. Bodamer, ed. 15 Jul. 1968 37 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951296)
(NASA-CR-95981; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Electrochemical studies during the first quarter of 1968 have been directed toward establishing the sources of capacity loss following heat sterilization of sealed cells. The effect of pack tightness was not clear within the limits examined. On the other hand, it was quite plain that longer sterilization periods cause greater losses than shorter periods. Initial work on the possible contribution of organic components has been ambiguous, and the experimental apparatus has been redesigned. The investigations of SWRIGX separator performance in sterilized silver-cadmium cells on cycle, charged stand, and float has been completed, and a final summary is included in this report. A float regime appears best for long life. Engineering studies of the use of Inconel, zirconium, and silver-boron filament composite have been begun with the aim of providing increased shock resistance for those cells carrying such requirements. Investigation of heat sterilizable, high cycle life batteries is in the early planning stage. The development of the soft landing 2000 watt-hour battery is on schedule. Author

N68-31526*# National Aeronautics and Space Administration, Washington, D. C.
SOLAR CELLS
1968 4 p
(NASA Facts S-6/3-68) GPO: HC $0.05; CFSTI: MF $0.65 CSCL 10A

Described are construction and operational parameters of solar cells for electrical power generation. The solar cell uses a silicon crystal to convert sunlight directly into electrical energy and thus provides the electrical power for unmanned space missions conducted by NASA. Phosphorus-boron containing silicon crystals in a solar cell measuring only one by two centimeters can produce a current of 60 milliamperes at four-tenth of a volt. G.G.

N68-31544# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DESIGN STUDY (OF) ELECTRICAL COMPONENT TECHNOLOGY FOR 0.25 TO 10.0 MEGAWATT SPACE POWER SYSTEMS. PARAMETRIC DESIGN STUDY OF CANNED AC INDUCTION MOTORS
T. C. Allen 15 Dec. 1967 134 p refs
(Contract AT(04-3)-679)
(SAN-679-5; WAED-67.52E) CFSTI: HC $3.00/MF $0.65

Parametric studies of canned ac induction motors for prime movers of centrifugal pumps for space nuclear electric power plants utilizing the Rankine conversion cycle is presented. The parametric data is suitable to determine minimum system weight as a function of shaft horsepower rating, frequency, synchronous speed, voltage, and coolant temperature for ratings between 5 and 250 horsepower. Author (NSA)

N68-31822*# Exotech, Inc., Washington, D. C.
PROTON-INDUCED DAMAGE TO SILICON SOLAR CELL ASSEMBLIES—A STATE-OF-THE-ART SURVEY Quarterly Report
M. J. Barrett and R. H. Stroud 10 Jul. 1968 35 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952246)
(NASA-CR-95997; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The literature concerning proton induced radiation damage to silicon solar cells and their coverslides is collected and reviewed. A summary of the state-of-the-art is presented, in which it is observed that the localized damage in the cell depends on the proton energy at the point being considered. Hence, it may be nonuniform across the thickness of the cell. Equations are available to allow computation of the effect of this damage on the electrical characteristics and are discussed. Author

N68-31825# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROCKET DETONATORS
A. N. Dorofeyev 14 Jul. 1967 84 p refs Transl. into ENGLISH of "Vzryvateli Raket" Moscow, Voyennoey Izd. Min. Oborony, 1963 p 1–87
(FTD-MT-66-153; AD-670962)

This report is intended for military personnel and students at military schools and for general readers. The construction and operating principles of percussion, time, and noncontact action detonators are described. Concise information on their development and classification is given. Existing time-detonator characteristics are illustrated by detonators used during the World War II. The book utilized unclassified Soviet and non-Soviet publications and belongs to the series Rocket Techniques, published by the Defense Ministry of the USSR. Author (TAB)

N68-31826# Naval Research Lab., Washington, D. C.
EFFECTS OF CONSTANT-CURRENT REVERSALS DURING CHARGE OF THE SILVER OXIDE ELECTRODE
Charles P. Wales 1 May 1968 20 p refs
(NRL-6695; AD-670733)

The sintered silver electrodes used in storage batteries were charged by a constant current, interrupted by periodic constant-current discharge. A large capacity increase was obtained when the charge current was reversed for 15 min out of every 60 min during a charge at the 20-hr rate, but this method greatly increased the total time required for a charge. Capacity could be improved a smaller amount, without charge time becoming excessive, by partly discharging the silver electrodes the first one or two times that the potential reached a chosen value near the end of a charge. In general, capacity improvement decreased as KOH concentration increased. Commercial silver-zinc cells always gave less improvement than the test cells. Author (TAB)

N68-31855# McDonnell Aircraft Corp., St. Louis, Mo.
INVESTIGATION OF ENVIRONMENTAL EFFECTS ON PURE FLUID AMPLIFIERS Final Report
Michael A. Madonna, Willard J. Harris, and Robert C. Anderson 1 Mar. 1968 290 p
(Contract DAAG39-67-C-0045)
(G102; AD-670956)

The report gives a detailed account of the performance of twelve typical fluidic amplifiers, six bistable and six proportional, when subjected to severe environmental operating conditions. Test conditions included, temperatures to 1500F, 40g sinusoidal vibration, 150 decibel sinusoidal acoustic excitation, and 180g shock. Performance changes during testing are discussed. Author (TAB)

N68-31910# California Univ., Livermore. Lawrence Radiation Lab.
ONE-DIMENSIONAL CALCULATIONS ON A FINITE-LENGTH MHD INDUCTION GENERATOR
M. Heusinkveld 11 Apr. 1968 41 p refs Presented at the Symp. on Magnetohydrodyn. Elec. Power Generation, Warsaw
(Contract W-7405-ENG-48)
(UCRL-70795; Conf-680704-1) CFSTI: HC $3.00/MF $0.65

The problem of the finite length induction converter is solved in the slit channel approximation, in which the transverse magnetic field does not vary across the gap. The fluid channel is assumed to be infinitely wide, or infinite conductivity side shorting bars are assumed for a channel of finite width. Slug flow and scalar electrical conductivity of the channel fluid and sinusoidal time variation are assumed. The magnetic pole pieces with infinite magnetic permeability extend from $x = 0$ to $x = 1$. The basic equation for the total magnetic induction B_t is deduced from Faraday's law. Equations are obtained for electrical impedance of the excitation winding, hydrodynamic power input, real and reactive electrical power output, and the energy conversion efficiency. Predictions from this analysis are compared with experimental data from a linear converter model. Results of numerical calculations of the problem of a uniform traveling wave generator of finite length are presented. NSA

N68-31926# Eagle-Picher Co., Joplin, Mo. Couples Dept.
MAGNESIUM/MAGNESIUM-PERCHLORATE MANGANESE DIOXIDE BATTERIES FOR FIELD RADIO APPLICATIONS Final Report, Nov. 1966–Feb. 1968
Earl B. Cupp Jun. 1968 98 p
(Contract DAAB07-67-C-0116)
(ECOM-0116-F; AD-670968)

The report describes the significant accomplishments made toward meeting the design goals for the Type 62 battery. The design effort directed toward lighter battery weight, nonspill features, activated storage and control of battery expansion are described in detail. The report concludes with the testing of a final 6.5 pound battery design which should meet the requirements for the Type 62 battery. Author (TAB)

N68-32056*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
REVIEW AND EVALUATION OF PAST SOLAR-CELL DEVELOPMENT EFFORTS Final Report, 1 Jun. 1966–31 May 1968
P. A. Crossley, G. T. Noel, and M. Wolf Jun. 1968 399 p refs
(Contract NASw-1427)
(NASA-CR-98161; AED-R-3346) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An historical account is provided of research done on the photovoltaic effect, and on devices which use this effect for power conversion. This account is used as the basis for a critical analysis and evaluation of the past research in this field, which was aimed at providing solar photovoltaic conversion devices for generating power in space. From this examination of past work, suggestions are derived for research into specific areas with reasonable high potential for yielding results which will provide improved devices for future application in space power systems. This report also contains an extensive bibliography listing the scientific publications, conference reports, and government contract reports which have been found relevant in this work. Author

N68-32103*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
CASCADED THERMOELECTRIC TEST GENERATOR, PHASE 1 Quarterly Progress Report, Feb. 23–May 31, 1968
31 May 1968 11 p Prepared for JPL
(Contracts NAS7-100; JPL-952196)
(NASA-CR-95996; WANL-PR(DDD)-001) CFSTI: HC $3.00/MF $0.65 CSCL 10B

This report covers the design and fabrication of a cascaded SiGe/PbTe thermoelectric test generator. This effort is being performed in two phases: Phase I consists of a detailed design and analysis of the cascaded test generator, and Phase II consists of the fabrication and checkout testing of the system. The work reported herein covers the initial design of the cascaded test generator under Phase I. The system concept, preliminary system design, and performance estimates are presented. Detailed performance maps have been intentionally omitted in order to keep this document unclassified. Author

N68-32106*# Zaromb Research Corp., Passaic, N. J.
HYDROGEN-OXYGEN FUEL CELL SYSTEM WITH REACTANT-SUPERSATURATED ELECTROLYTE FEED Final Report, 21 Nov. 1966–20 May 1967
Solomon Zaromb 10 Jul. 1967 84 p refs
(Contract NAS7-531)
(NASA-CR-96143) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A conceptual design analysis was performed for the purpose of evaluating the feasibility and advantages of a supersaturated feed fuel cell (SFFC) based on packing reactants into electrolyte solutions under high pressure followed by circulation of the loaded electrolytes through appropriate porous electrodes. This study was confined to low temperature alkaline H_2-O_2 fuel cells. Tentatively assumed normal operating conditions of 75°C at 10 atm system pressure and 200 atm reactant saturation pressures, 5 M KOH, and 0.25 amp/cm^2 apparent electrode area, yield a predicted output voltage of at least 1.10 v/cell for the SFFC as compared with only 0.90 v/cell or less for gaseous-diffusion type or for recently considered undersaturated flooded-flow systems. The SFFC system was shown to be stable and, in part, self-regulating. Author

N68-32185* Electro-Optical Systems, Inc., Pasadena, Calif.
THERMIONIC RESEARCH AND DEVELOPMENT PROGRAM Final Report, 15 Jul. 1966–15 Jan. 1968
A. E. Campbell and D. L. Jacobson 1 Mar. 1968 146 p refs
(Contract NAS7-514)
(NASA-CR-96148; EOS-7118) CFSTI: $3.00 CSCL 10A

An overview of a research program designed to improve the output performance of low emitter temperature, cesium-vapor thermionic converters is presented. Task I involved the design and fabrication to two ultrahigh vacuum instruments in which electron emission (vacuum), surface uniformity, secondary recrystallization, and electrode preparation techniques of planar emitters could be measured or evaluated; and also involved a limited metallurgical investigation of crystallographic orientation, material purity and density, and surface structure. Task II comprised the fabrication and operation of variable parameter test vehicles for the purpose of measuring cesium vapor converter output performance at low emitter temperatures. Two variable parameter test vehicles were operated, and parametric studies were conducted employing a vapor deposited rhenium emitter/vapor deposited rhenium collector selected from Task I, and a polycrystalline rhenium emitter/molybdenum collector. Two planar converters were fabricated and tested to demonstrate performance of the vapor deposited rhenium system and to correlate research data from the test vehicles. Task III encompasses the interpretation of experimental results, particularly regarding the variable parameter test vehicle operation. S.C.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-30948 Centre National de la Recherche Scientifique, Paris (France).
RECORDING OF SIMPLE ACOUSTIC SIGNALS AT THE LEVEL OF THE HUMAN TYMPANUM [ENREGISTREMENT DE SIGNAUX ACOUSTIQUES SIMPLES AU NIVEAU DU TYMPAN HUMAIN]
Jean Forest [1965] 7 p refs In FRENCH
CFSTI: $3.00

Details are given on the experimental techniques and apparatus used to record the responses of subjects to sound signals transmitted to their eardrums. Comparisons are drawn between the acoustic pressure measured at the external ear and at the eardrum for variable pure frequencies and for rattling noise. Wide variations in human response were noted. The data obtained were considered in the context of developing electro-acoustical analogies between the external ear and the response of a structure to auditory stimulation. Transl. by M.G.J.

N68-30963# Universidad Peruana de Ciencias Medicas y Biologicas, Lima (Peru).
CELLULAR AND TISULAR ADAPTATION TO HYPOXIA Annual Report, Apr. 1967–Mar. 1968
Alberto Cazorla Mar. 1968 66 p refs
(Grant DA-ARO(D)-49-092-66-G123)
(AR-2; AD-671030)

The following adaptive mechanisms to chronic hypoxia are under investigation: (1) Larger P/O ratio in vivo; (2) Increased anaerobic energy production; (3) Changes in citric acid cycle intermediate concentrations. The concentrations of L-Lactate and L-alpha-glycerophosphate in red muscle, white muscle, liver and heart from high altitude guinea pigs, under aerobic and ischemic conditions were determined. Considering the results obtained, enough evidence is presented to discard a previous hypothesis, which stated that L-alpha-glycerophosphate has an important role as final product of anaerobic glycolysis. The results of these investigations show a reduced accumulation of these substances in the ischemic liver of animals from high altitude as compared to those from sea level. This suggests among other possibilities that liver tissue of animals adapted to chronic hypoxia metabolize L-Lactate more efficiently in ischemic conditions. The results in other tissues are also discussed. Using gas-liquid chromatography, red muscle, liver, heart and kidney tissue under conditions of ischemia at sea level and high altitude were analyzed for the Krebs cycle intermediates. Succinic, malic, and citric acids are easily measurable. Obvious differences in succinic acid concentration were found between the two groups, and 2 unknown substances were found only in kidney and heart tissue from high altitude animals. Author (TAB)

N68-31008*# Baylor Univ., Houston, Tex. Coll. of Medicine
COMPREHENSIVE BIOLOGICAL PROTOCOL FOR THE LUNAR SAMPLE RECEIVING LABORATORY
16 Jun. 1967 572 p refs
(Contract NAS9-6157)
(NASA-CR-92209; MSC-DA-D-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 06M

This study concerns the biological quarantine for the safe handling and study of lunar material to be returned to earth from early Apollo missions. It is planned to isolate such material as well

as the spacecraft and the crew initially while the lunar sample would be tested for the possible presence of agents that might be infectious or toxic for man, animals, and plants. The three main elements of the study are: (1) crew microbiology; (2) *in vitro* attempts to culture microorganisms from the lunar sample; and (3) the direct challenge of the lunar sample in biological system. Although broad in scope, this study contains detailed instructive information and technical data for the laboratory tests of the lunar sample in representative members of all major taxa. K.W.

N68-31035# Research Triangle Inst., Durham, N. C.
AN ATMOSPHERIC PHYSICS AND CHEMISTRY STUDY ON PIKES PEAK IN SUPPORT OF PULMONARY EDEMA RESEARCH Final Report, 13 Mar. 1967–12 May 1968
Harry L. Hamilton, Jr., James J. B. Worth, and Lyman A. Ripperton May 1968 58 p refs
(Contract DAHC19-67-C-0029)
(AD-670989)

Measurements of atmospheric trace gases on the summit of Pikes Peak (14,110 ft) from late July through mid-October 1967 were made in support of pulmonary edema research. Supporting meteorological data were also collected. Local intermittent contamination by combustion products afforded an opportunity to examine conditions corresponding to those which might be experienced by troops in encampments. Concentrations of ozone (O3), in uncontaminated air showed a maximum at night and a minimum during the daytime. The daytime minimum is attributed to mixing of the air from the altitude of the peak with O3-depleted air from near ground level in adjacent valleys and plains. In contaminated air, O3 concentration on the average showed no maximum, and mean values for each hour were considerably lower than in uncontaminated air. This reduction results from destruction of ozone by NO from combustion products; measured concentrations of NO appear adequate to account for the decrease in O3. Auxiliary stations for O3 measurement on the mountainside (10,840 ft) and at the base of the mountain (7,780 ft) showed the daytime maximum and nighttime minimum normally experienced in the lowlands. A trend from high concentrations of O3 in July to lower concentration in October is apparent, conforming with the normal pattern of tropospheric ozone. A dampening of the diurnal wave pattern of O3 concentration is evident as the average concentration decreases. Author (TAB)

N68-31059# Universidad Peruana de Ciencias Medicas Y Biologicas, Lima (Peru). Instituto de Investigaciones de la Altura.
HORMONE METABOLISM IN MEN EXPOSED TO HIGH ELEVATION Annual Report, 1 May 1967–30 Apr. 1968
Roger Guerra-Garcia Apr. 1968 12 p refs
(Contract DAHC19-67-G-0021)
(AR-2; AD-671035)

Data are presented on Testosterone Production Rate (TPR) in eight normal men acutely exposed to high altitude. The mean control value at sea level was 6.693 mg/24 hr. similar to that obtained after 60 hr. in Cerro de Pasco (altitude 14,200 ft) 5.648 mg/24 hs. ($p>0.5$). However, there was a considerable individual variation and no correlation between the TPR and the urinary excretion of testosterone. It is concluded that the determination of the TPR by urinary methods is not adequate in circumstances of adrenal stimulation by ACTH. The excretion of radioactivity in the urine was similar at sea level and high altitude: 79.4 and 78.2% respectively; the same occurred with the 17-Ketosteroids for which mean values were 19.77 and 22.09 mg/48 hr. ($p>0.5$). Author (TAB)

N68-31215*# Linde Co., Tonawanda, N. Y. Research Lab.
DECOMPRESSION PROCEDURES FOR THE SAFE ASCENT OF AEROSPACE PERSONNEL—GROUND LEVEL TO ALTITUDE Final Report
4 May 1968 64 p refs
(Contract NAS9-6978)
(NASA-CR-92212) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The Tonawanda II model of inert gas transport was studied as a predictor of incidence of decompression sickness in flight profiles by using calculated inert gas tensions in the ascent-limiting compartment. Time course of the sum of inert gas partial pressures was calculated in 12 simulated MOL profiles flown in altitude chambers, and the 12 profiles were ranked in terms of relative severity of the episodes of supersaturation associated with each. When this ranking was compared with actual bends experience associated, the mathematical model predicted 10 of the profiles. Computer analyses were made of 388 flight records, using the highest Haldane ratio sustained in each flight as the basis for correlation with incidence of decompression sickness. Incidence increased with increasing maximum Haldane ratio except for an abnormally low rate in the 2.21 to 2.40 ratio for flights in which helium was not breathed. Data are included for nitrogen flights, and graphic displays were prepared of the time course of inert gas tensions. M.W.R.

N68-31315# John B. Pierce Foundation of Connecticut, New Haven.
ON THE STUDY OF THE EFFECTS OF ADDITIONAL ENDOGENOUS HEAT Annual Report, 1 Jul. 1966–30 Jun. 1967
James D. Hardy, Robert O. Rawson, and Jan A. J. Stolwijk 1967 88 p refs
(Contract PH-43-66-978)
(PB-176914) CFSTI: HC $3.00/MF $0.65

It was proposed to design heat exchange devices and experiments to study the effects of introducing heat internally in experimental animals; to study the effects of this additional heat upon tissue immediately adjacent to the heat sources, and its effects upon the organism as a whole. Electrical heat sources were designed and implanted to deliver heat subcutaneously, and intravenously, perivascularly, submuscularly and intra-abdominally. The addition of endogenous heat submuscularly or intra-abdominally proved to be a feasible approach to this problem. It was learned from these experiments that high interface temperatures of 45°C, usually considered detrimental to tissue cell continuity, stimulate rapid compensatory mechanisms of action which may prove to be a valuable asset to the further development of heat exchange systems implanted within the body. Author (USGRDR)

N68-31335# Indiana Univ., Bloomington. Dept. of Psychology.
A COMPARISON OF GSR AND SUBJECTIVE ADAPTATION TO STRESSFUL STIMULI
Robert M. Stern (Pa. State Univ.), Larry Gaupp (Pa. State Univ.), and William C. Leonard Jul. 1968 23 p refs
(Contract Nonr-908(15))
(TR-25; AD-671199)

The purpose of this study was to compare subjective and physiological adaptation, as measured by magnitude of GSRs, to electric shock and auditory noise. In Exp. I 48 Ss received 15 shocks of constant intensity, one subgroup always receiving low shocks, the other high. Ss were told that shock intensity would vary and rated the intensity of each shock immediately following its presentation. In Exp. II the same procedure was followed with 50 different Ss using noises instead of shocks. Shock Ss showed significant subjective adaptation but no GSR adaptation. Noise Ss showed GSR adaptation with a significant increase in subjective intensity reports. The importance of anticipation, in terms of level of arousal, at the onset of the session is discussed. Author (TAB)

N68-31350*# Battelle Memorial Inst., Richland, Wash. Dept. of Biology.
INFLUENCE OF CHRONIC RESTRAINT ON GASTROINTESTINAL FUNCTION IN THE RAT Final Technical Report

M. F. Sullivan [1968] 67 p refs
(NASA Order A-73704)
(NASA-CR-73233; BNWL-CC-1159-6) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Effects of chronic restraint on body weights and gastrointestinal movements of rats was studied under normal, high fat, and low fat diets and with cobalt 60 irradiation. Restraint depressed growth rate of animals on normal diets; and low fat diets reduced growth rates, with restraint further reducing growth rate. While nonrestrained animals on high fat diets had normal growth rates, restrained animals on this diet exhibited low or negative rates. Both sham irradiation and continuous exposure at 50 R affected restrained animals slightly more than nonrestrained animals, but 300 R daily irradiation eliminated any difference in weight loss between the groups. Little or no difference was found between passage times of intestinal contents of either group of animals on normal diets, although passage time for restrained animals on either low or high fat diets was slightly faster. Little difference was found in either group when exposed to irradiation, and there was little change in bacterial content with respect to restraint or diet. M.W.R.

N68-31382# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
EVALUATION OF THE RAPID RECOMPRESSION-HIGH PRESSURE OXYGENATION APPROACH TO THE TREATMENT OF TRAUMATIC CEREBRAL EMBOLISM
Larry Van Gehderen and Charles L. Waite 25 Mar. 1968 14 p refs
(SMRL-519; AD-670613)

The study compares the conventional Navy recompression treatment tables and the newer rapid recompression-high pressure oxygenation (RR-HPO) method for the treatment of traumatic cerebral air embolism. Seven cases are presented. These cases occurred as a result of submarine escape training at the Naval Submarine Base, Groton, Connecticut, and were successfully treated with the latter method. Factors regarding the rationale of the use of this new approach are discussed. Since the writing of this paper, the Navy Department has approved the treatment schedules recommended herein for the treatment of traumatic air embolism. Author (TAB)

N68-31392# Japan Atomic Energy Research Inst., Tokyo.
STUDIES ON THE THYROID FUNCTION TESTS BY MEANS OF WHOLE BODY LINEAR SCANNING
Yoshiko Osiumi, Keiichi Matsuura, Hideyasu Kiyonari, Hisashi Kawanami, and Masataka Inakura Jun. 1968 16 p refs Transl. into ENGLISH from Nippon Acta Radiol., v. 26, no. 11, Feb. 1967 p 1462–1470
(NSJ-TR-120) CFSTI: $3.00

This study was combined by whole body linear scanning and ^{131}I-uptake in 1, 3, 6 and 24 hours respectively after oral administration of Na^{131}I. And it was studied how ^{131}I distribution in the body changed referring to time and thyroid function. The curve of whole body scanning has two remarkable peaks. One showing the amount of ^{131}I taken in thyroid gland is the area corresponding to thyroid gland. The other is recognized between xyphoid process and umbilicus, which means ^{131}I distributed in many organs such as stomach, liver, spleen, pancreas and small intestine. But it is considered that stomach plays the most important role for the account of the latter peak. The height and area of these peaks change referring to time and the changes are influenced by the condition of thyroid function. The relation between the area of these peaks and thyroid function was investigated. Consequently we confirmed that the peak recognized between xyphoid process and umbilicus showed exactly the condition of thyroid function in 6 hours after administration. Author

N68-31408# California Univ., Los Angeles. Radiology Dept.
USE OF CHROMOSOME ABERRATIONS TO ESTIMATE X-RAY AND GAMMA-RAY DOSE TO MAN
Amos Norman, Masao S. Sasaki, Richard E. Ottoman, and Robert C. Veomett Brooks AFB, Tex. School of Aerospace Med. Dec. 1967 24 p refs
(Contract AF 41(609)-2944)
(SAM-TR-67-112; AD-666713)

The frequency of chromosome aberrations in lymphocytes taken from the peripheral blood provides a useful measure of absorbed dose. The estimation of dose is affected by time in culture of the lymphocytes, by sampling error and sampling time, and by size, rate, distribution, and quality of radiation dose. Data on the effect of these variables are presented. Dose is estimated for five people accidentially exposed to ionizing radiation. Four appendixes give a detailed account of optimal technics for making chromosome preparations, the yields of aberrations as a function of dose in 50-hour and 72-hour cultures, and the yield of acentric fragments per dicentric. Author (TAB)

N68-31442# Texas Univ., Austin. Electrical Engineering Research Lab.
COMPARISON OF INSECTS' FLIGHT CHARACTERISTICS WITH OBSERVED CHARACTERISTICS OF RADAR DOT ANGELS
M. S. Fowler and A. H. La Grone 24 Apr. 1967 18 p refs
(Grant NSF-GP-2596)
(P-14)

An overview is presented on the literature search undertaken to determine the characteristics of insect flight. The data discussed include wind tunnel studies as well as field observations of flight speeds, flight ranges, and insect density in the atmosphere. Tabulated data show the continuous (cruising) speed, maximum speed over short distances, speed of flight, and range of flight and endurance of stockflies (Diptera), mosquitoes (Diptera), Buffalo gnats or black flies (Diptera), honeybee (Hymenoptera), and pomace fly or vinegar fly (Diptera). It was concluded: (1) Speeds at which insects are capable of flying plus measured wind speeds at dot angel echo altitudes are consistent with radar observation of dot angel echo movement. (2) Altitudes at which insects were found in flight agree with altitudes at which dot angel echoes are normally found. (3) Insect flight endurance can easily account for the relatively long times that dot angels have been tracked. (4) Although the polarization characteristics of the insect body do not appear to be a usable way of identifying insects as dot angel echoes, insects must remain as prime candidates for the source of these echoes. M.G.J.

N68-31459*# Naval School of Aviation Medicine, Pensacola, Fla.
PREVENTION OF OVERT MOTION SICKNESS BY INCREMENTAL EXPOSURE TO OTHERWISE HIGHLY STRESSFUL CORIOLIS ACCELERATIONS
Ashton Graybiel, F. Robert Deane, and James K. Colehour 20 Jun. 1968 14 p refs
(NASA Order R-93)
(NASA-CR-96122; NAMI-1044) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Four Navy enlisted men were exposed in a slow rotation room (SRR) by stepwise increases over a period of 18 days to a terminal velocity of 10 rpm. The fact that overt symptoms of motion sickness at 10 rpm were prevented solely by the incremental increases demonstrated that adaptive processes somehow inhibited irradiation of vestibular activity to cell assemblies in areas concerned in the genesis of symptoms. The SRR sickness observed in other subjects suddenly exposed to 10 rpm thus may result from failure of homeostatic processes, permitting such irradiation. The underlying processes therefore are clearly nonhomeostatic in nature and produce a nonhomeostatic state. The findings in the experiment have practical as well as theoretical implications. Author

N68-31468# Stanford Research Inst., Menlo Park, Calif.
INVESTIGATIONS OF LASER DAMAGE TO OCULAR TISSUES Final Report, 5 Apr. 1967–5 Feb. 1968
A. Vassiliadis, R. C. Honey, N. A. Peppers, H. C. Zweng, R. C. Rosan et al Mar. 1968 98 p refs
(Contract F33615-67-C-1752)
(AD-670852)

Results of experimental investigations to determine threshold levels for minimally-sized retinal lesions caused by neodymium long-pulsed and Q-switched lasers are presented. The experimental animals were rhesus monkeys. In addition, results of retinal damage due to Q-switched ruby, neodymium, and doubled neodymium lasers at suprathreshold energy levels are also presented. A report on histopathology of retinal injury caused by Q-switched lasers is presented. Observations on damage due to both ruby and neodymium lasers are discussed. The design and construction of a fundus reflectometer is described, and preliminary measurements of fundus reflectance of rabbit, rhesus monkey, and human subjects are reported. Results of an experimental investigation to determine threshold damage levels for a CO2 laser to rabbit corneas are given. Data for three exposure times are included. In addition, theoretical calculations based on a one-dimensional heat-flow model are reported, and comparison is made with the experimental results. Finally, some results on permanent corneal damage due to CO2 laser are reported. Author (TAB)

N68-31501*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Systems Studies Div. 1741.
THE CHANCES OF RETRIEVAL OF VIABLE MICROORGANISMS DEPOSITED ON THE MOON BY UNMANNED LUNAR PROBES
Martin S. Tierney Aug. 1968 97 p refs
(NASA Order R-09-019-040)
(NASA-CR-96121; SC-M-68-539) CFSTI: HC $3.00/MF $0.65 CSCL 06M

An attempt was made to estimate the density of the bioburden of the moon resulting from unmanned lunar probes. Accordingly, models were developed which estimate lunar probe bioburdens at launch and upon contact with the lunar surface. For hard impacts, two possible mechanisms for disseminating microorganisms on the lunar surface are modeled: Dispersal in crater ejecta and dispersal on lunar probe fragments. The expected density of terrestrial microorganisms on the moon is calculated at the time of impact, and subsequent survival is investigated. Some estimates are made of the probability of retrieving a lunar sample containing terrestrial microorganisms deposited by unmanned lunar probes. Author

N68-31591*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
HISTOLOGICAL DISTRIBUTION AND RETENTION OF LEAD, RADIOACTIVE SULFUR, AND RADIOACTIVE CALCIUM IN COMPACT BONE [DISTRIBUTION HISTOLOGIQUE ET RETENTION DU PLOMB, DU RADIOSOUFRE ET DU RADIOCALCIUM DANS L'OS COMPACT]
J. Vincent Washington NASA Aug. 1968 6 p refs Transl. into ENGLISH from Radioisotopes, Sci. Council for Africa S. of the Sahara Publ. no. 28 (Pretoria), 1957 p 41–45
(Contract NASw-1692)
(NASA-TT-F-11862) CFSTI: HC $3.00/MF $0.65 CSCL 06R

The pattern of deposition of new bone substance in dogs and monkeys is investigated by histological means with lead and by radiological means with X-rays and radioactive isotopes, including calcium-45. It is found that the new deposit is at first calcium-poor and then undergoes massive calcification, during which a radioactive isotope can be co-deposited. Some inferences with regard to uptake and both short-term and long-term retention of radioactive isotopes by the animal or human skeleton are drawn, and avenues for further research are mentioned. Author

N68-31645# Brookhaven National Lab., Upton, N. Y.
SOURCES OF FISSION NEUTRONS AND THEIR DOSIMETRY
Ralph G. Fairchild [1968] 14 p refs Presented at the Meeting of the Transplutonium Program Comm., Germantown, Md.
(BNL-12452; CONF-680420-2) CFSTI: HC $3.00/MF $0.65

Sources of spontaneous fission neutrons are listed, and their possible therapeutic use is discussed. Dosimetry of a californium-252 fission neutron source in a tissue-equivalent phantom is described. NSA

N68-31666# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HIT THEORY AND MICRODOSIMETRY
W. C. Roesch 1 Apr. 1968 13 p Presented at the 6th Ann. Radiation Res. Society Meeting, Houston, Tex.
(Contract AT(45-1)-1830)
(BNWL-SA-1753; CONF-680421-2) CFSTI: HC $3.00/MF $0.65

Hit theory and microdosimetry are discussed, and an illustration of their use in the study of the RBE problem is presented in an effort to describe radiation effects on biological systems. NSA

N68-31737# American Inst. of Biological Sciences, Washington, D. C.
THE STATUS AND POTENTIAL OF AQUACULTURE, PARTICULARLY INVERTEBRATE AND ALGAE CULTURE. VOLUME 1. PART 1: THE STATUS AND POTENTIAL OF AQUA CULTURE. PART 2: INVERTEBRATE AND ALGAE CULTURE
John H. Ryther and John E. Bardach May 1968 312 p refs Sponsored by the Natl. Council on Marine Resources and Eng. Develop.
(PB-177767) CFSTI: HC $3.00/MF $0.65

The report deals with the present status of aquaculture in the world today, with some remarks on its potential contribution to the war on hunger. The conclusion is that the practice of aquaculture may not only be greatly expanded, but also that its yields may be very appreciably increased through the use of modern science and technology. Existing techniques are already available for immediate application and quick return. Aquacultural practices were surveyed with respect to the different species of organisms in culture; the different countries of the world, with consideration given to climate, race, and economic development; and the different levels of intensity and technological sophistication which are in current use. For each example, as much information as possible was obtained on the basic biology and ecology of the organism in culture, the procedures and techniques employed in the practice, and yields and economics of the operation, if commercial. Sources of the information consisted of: (1) the published scientific literature; (2) unpublished reports; (3) correspondence; and (4) personal visits by the authors to the sites where aquaculture is practiced in the United States and in 10 other countries around the world. USGRDR

N68-31842*# Oregon State Univ., Corvallis.
MICROORGANISM STUDY: SYSTEMATIC DESCRIPTION AND KEY TO ISOLANTS FROM MEXICO Progress Report
W. B. Bollen 1 Jun. 1968 14 p Prepared for JPL
(Contracts NAS7-100; JPL-950783)
(NASA-CR-96135) CFSTI: HC $3.00/MF $0.65 CSCL 06M

This report identifies isolants from soils of Mexico. Of the seven isolants reported one, 250 Aa, is an actinomycete; the remaining six are bacteria. A dichotomous key and a list of the isolants and species designations precede the descriptive charts for each isolant. A photomicrograph for the one non-viable isolant, 250 Ba, is also included. The bacterial isolants are all species of the genera *Bacillus*. Isolant numbers 250 Bb, 251 Aa and 251 Ab are *Bacillus cereus*. Isolant numbers 250 Aa and 251 Bb are *B. subtilis*. The cultural characteristics and physiological tests for the

three species of *B. cereus* are all the same. The two *B. subtilis* isolants varied in cultural characteristics, litmus milk reactions, hydrolysis of casein, and temperature relationships. Isolant number 251 Bb resembles *B. coagulans* in milk reactions and casein hydrolysis, although the remaining majority of characteristics are like *B. subtilis*. Author

N68-31916# Royal Aircraft Establishment, Farnborough (England).
ON THE PROBLEM OF INFLUENCING SPONTANEOUS NYSTAGMUS BY MEANS OF DIMENHYDRINATE [ZUR FRAGE EINER BEEINFLUSSUNG DES SPONTANNYSTAGMUS DURCH DIMENHYDRINAT]
F. Krejci and H. Bornschein Apr. 1968 7 p Transl. into ENGLISH from Practica Oto-Rhino-Laryngol. (Germany), V. 17, 1955 p 337-342
(RAE-LIB-TRANS-1298) CFSTI: HC $3.00/MF $0.65

Electronystagmographic examination of the effect of large doses of dimenhydrinate (300 mg i.m.) on spontaneous nystagmus of various origin in 11 patients is described. Six out of seven cases of spontaneous nystagmus of labyrinthine origin showed a temporary suppression or diminution of the nystagmus, but no effect could be observed in four cases of nystagmus of central origin. The results are discussed in view of the uncertain mechanism of the action of this drug. Author

N68-32030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-REGULATION OF HIGHER NERVOUS ACTIVITY
A. A. Krauklis 6 Dec. 1967 299 p refs Transl. into ENGLISH of the book "Samoregulyatsiya Vysshey Nervnoy Deyatel'nosti" Riga, Izd. AN Latv. SSR, 1964 p 1-291
(FTD-HT-23-808-67; AD-669273)

Self-regulation of the nervous system by means of conditioned reflex reproduction of effector reactions advantageous for so-called compensatory reactions guarantees the conservation of an optimal regimen and adequate level of integration of higher nervous system activity in animals and, in particular, in man. The adequacy and economy of these mechanisms in most connections depends on the adaptive effectiveness of all psychic human activities. Therefore, the problem of improving and stabilizing the self-regulation of higher nervous activity is the basic physiological content of human psychohygiene and psychoprophylaxis. In the present work the possible physiological mechanisms for the self-regulation of higher nervous activity are examined in animals and in man, as well as the significance of disturbances of these mechanisms in the function of internal organs. Author (TAB)

N68-32088# Pasadena Foundation for Medical Research, Calif. Laser Biology Lab.
EFFECT OF RUBY LASER ENERGY ON THE HUMAN IRIS
A. Ray Irvine, Jr., Donald E. Rounds, and Robert S. Olson Brooks AFB, Tex. School of Aerospace Med. Mar. 1968 13 p refs
(Contract F41609-67-C-0022)
(SAM-TR-68-34; AD-670864)

Excised rings of iridial sphincter muscle taken from recently enucleated human eyes were monitored for their contractile and tearing response after treatment with varying photon densities from a pulsed ruby laser. The response was linear between 0 to 26 J/sq cm, but variable above that energy density level. A comparison of this response with that of rings of hamster dorsal aorta suggested that the variability was due to iridial tissue damage. This hypothesis was supported with observations that the iris showed variable degrees of destruction after the sectioning of intact eyes exposed to a laser dose range between 28 and 2200 J/sq cm. These methods suggested that the threshold of ruby laser energy which would impair the functional activity of the iris was approximately ten times the damage threshold level for the human retina. Additional work was called for to evaluate the effect of iridial damage on visual acuity. Author (TAB)

N68-32131# Johann-Wolfgang-Goethe-Universitat, Frankfurt Am Main (West Germany).
EXTRATERRESTRIAL BIOPHYSICS, BIOLOGY AND SPACE MEDICINE
H. Buecker, ed. Bundesministerium Fuer Wiss. Forsch. Jun. 1968 365 p refs In ENGLISH and GERMAN 2d meeting held at Marburg, 9-10 Oct. 1968 Prepared jointly with Philippe-Univ.
(BMwF-FB-W-68-30) CFSTI: HC $3.00/MF $0.65

Conference papers are presented on the NASA bioscience program, radiation problems, extraterrestrial experiments, chemical evolution and exobiology, and aerospace medicine. For individual titles, see N68-32132 through N68-32154.

N68-32132*# National Aeronautics and Space Administration, Washington, D. C.
THE BIOSCIENCE PROGRAMS OF NASA
Orr E. Reynolds *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 19-42 (See N68-32131 19-04)
CSCL 06C

A program outline with representative examples is presented of basic research related to biological space exploration, research and development of flight experiments, and actual flight experiments. Mentioned are features of such projects as the radioisotope probe Gulliver, the Wolf Trap probe, and the Biosatellite program. K.W.

N68-32133# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
ACUTE AND CHRONIC RADIATION HAZARDS FOR MAN IN EXTRATERRESTRIAL SPACE [AKUTE UND CHRONISCHE STRAHLENGEFAEHRDUNG DES MENSCHEN IM EXTRATERRESTRISCHEN RAUM]
H. Buecker *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 43-70 refs In GERMAN (See N68-32131 19-04)

Galactic radiation, the radiation of the Van Allen belt, and solar corpuscular radiation are analyzed in terms of dosimetry and radiation protection for astronauts. Doses below 100 mrad/24 hrs are expected from galactic radiation, while the Van Allen belt radiation will at times exceed 220 rad/hr. Even greater doses must be expected from solar flares. Depth of radiation penetration, distribution in the human body, shielding requirements, and best launching dates for minimum radiation exposure are studied. Transl. by K.W.

N68-32134# Hamburg Univ. (West Germany). Strahlenbiologisches Institut.
BIOLOGICAL EFFECTS OF QUANTA IN THE GEV RANGE [ZUR BIOLOGISCHEN WIRKUNG VON QUANTEN IM GEV BEREICH]
Hans A. Kuenkel, Fritz Staehler, and Friedrich Zywietz *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 71-80 In GERMAN (See N68-32131 19-04)

Electron synchroton irradiation experiments were conducted in the energy range from 2 to 6 GeV. In preliminary dosimetry experiments, readings with a duplex dosimeter with a thin-walled ionization chamber were compared with those of a quantum meter and with extinction measurements on irradiated ferrosulfate samples. Also measured were the build-up effect, depth of penetration, and dependence on quantum energy. The biological irradiation experiments were performed with dormant seeds and germinated seedlings of *Vicia faba*. The rate of mitosis was determined as a function of dosis and length of exposure. It was found that the biological effect of photon irradiation in this energy range is not as strong as that of conventional X rays. Particularly noted was a greater capacity for recovery after exposure to high-energy quanta and a strong build-up effect in deep layers of the material. Transl. by K.W.

N68-32135# Philipps-Universitat, Marburg (West Germany). Institut fuer Strahlenbiologie und Medizinische Isotopenanwendung.
RADIATION DOSIMETRY IN SPACE WITH TISSUE-EQUIVALENT DETECTORS [ZUR STRAHLENDOSIMETRIE IM WELTRAUM MIT GEWEBEAEQUIVALENTEN DETEKTOREN]
H. Krueger and E. H. Graul *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 81–89 refs In GERMAN (See N68-32131 19-04)

Theory and construction of an experimental tissue-equivalent spherical proportional counter for determining the dosis-equivalent of mixed radiation in space is described. The composition of the counter's material closely resembles that of muscle tissue: 35.22% $C_8H_{11}ON$, 16.06% carbon, 45.14% polyethylene, and 3.58% CaF_2. The sphere is filled with a gas mixture of 32.4% CO_2, 3.4% N_2 and 64.2% CH_4. Accuracy of the counter and the calibration with a Po 210 source are briefly described.
Transl. by K.W.

N68-32136# Kernforschungsanlage, Juelich (West Germany). Institut fuer Botanik und Mikrobiologie.
EFFECT OF X-RAYS ON MICROCOCCUS DENITRIFICANS [DER EINFLUSS VON ROENTGENSTRAHLEN AUF MICROCOCCUS DENITRIFICANS]
Bernhard Muetze *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 91–99 In GERMAN (See N68-32131 19-04)

Micrococcus denitrificans were exposed to X rays in the heterotrophic and autotrophic state and under aerobic and anaerobic conditions. Observed were the rate of mitosis, viability, metabolism, the hydrogenase system, the nitroreduction system, electron transport, growth, and deformation.
Transl. by K.W.

N68-32137# Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany).
DEVELOPMENT OF AN EXTRATERRESTRIAL BIOLOGICAL EXPERIMENT UP TO READINESS FOR FLIGHT [DIE ENTWICKLUNG EINES EXTRATERRESTRISCHEN BIOLOGISCHEN EXPERIMENTES BIS ZUR FLUGREIFE]
Robert G. A. Lotz *In its* Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 101–113 refs In GERMAN (See N68-32131 19-04)

An experiment involving *Hirudo medicinalis* is used to demonstrate the problems encountered by a biologist in designing and developing a scientific experiment for inclusion on a biological satellite. Details are discussed concerning the design of the probe and the closed ecological system, including oxygen supply, feeding, removal of excretion, temperature and pressure control, sterilization, bioinstrumentation, and telemetry.
Transl. by K.W.

N68-32138# Arbeitsgruppe Biophysikalische Raumforschung, Frankfurt am Main (West Germany).
STUDIES OF THE BEHAVIOR OF BIOLOGICAL OBJECTS IN VACUUM AND ULTRAHIGH VACUUM [ZUM VERHALTEN BIOLOGISCHER OBJEKTE IM VAKUUM UND IM ULTRAHOCHVAKUUM]
Horst Buecker *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 115–134 refs In GERMAN (See N68-32131 19-04)

The significance of vacuum and ultrahigh vacuum studies with biological objects is discussed with reference to studies of the possible existence of life in the universe, sterilization and contamination, radiation effects in space, and the vacuum mechanism affecting biological objects. Theories concerning the evolution, survival, and transfer of life in space are analyzed, including the possibility of escape of microorganisms from earth. Results are presented of vacuum chamber experiments in which mass spectrometric measurements and water vapor desorption data were obtained of *Bacillus subtilis* and *Bacterium E. coli*. Also shown is an ultrahigh vacuum chamber specifically designed for biological experiments.
Transl. by K.W.

N68-32139# Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung E. V., Darmstadt (West Germany).
STUDIES ON THE PROBLEM OF THE PANSPERMIA [UNTERSUCHUNGEN ZUM PROBLEM DER PANSPERMIE]
Ehrenfried Petras *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 135–142 refs In GERMAN (See N68-32131 19-04)

The panspermia theory is critically analyzed in view of recent developments in space travel and exploration. Conditions for survival of microorganisms inside of meteorites during interstellar travel and during free travel due to radiation pressure are discussed. Various theories and experimental findings are evaluated concerning the survival of microorganisms in ultrahigh vacuum and at low temperatures. The effects of weightlessness and UV radiation are assessed.
Transl. by K.W.

N68-32140# Gottingen Univ. (West Germany). Institut fuer Mikrobiologie.
GROWTH PHYSIOLOGY OF NEW PHYLA OF OXYHYDROGEN GAS BACTERIA [WACHSTUMSPHYSIOLOGIE NEUER STAEMME VON KNALLGASBAKTERIEN]
H. G. Schlegel and R. Lafferty *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 143–152 refs In GERMAN (See N68-32131 19-04)

Greater synthesis efficiency is the chief advantage of the gas electrolysis–bacteria system over the photosynthesis–green algae system for the regeneration of breathing air and human wastes at a permanent lunar station. However, the H_2-oxidizing bacteria system lags behind in development. This paper reviews three parallel research programs aimed at conditioning the bacteria for carbon dioxide and gas electrolysis for the synthesis of organic materials: (1) isolation of new types of H_2-oxidizing bacteria such as pseudomona and mycobacteria; (2) the further development of culture techniques for oxyhydrogen gas bacteria; and (3) the application of mutation techniques to obtain productive mutants.
Transl. by K.W.

N68-32141# Gottingen Univ. (West Germany). Institut fuer Mikrobiologie.
UTILIZATION OF ORGANIC NITROGEN COMPOUNDS BY HYDROGENOMONAS SPECIES [VERWERTUNG ORGANISCHER STICKSTOFFVERBINDUNGEN DURCH HYDROGENOMONAS-ARTEN]
Heinrich Kaltwasser *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 153–160 refs In GERMAN (See N68-32131 19-04)

The equations for the basic chemical processes in a culture of oxyhydrogen gas bacteria are discussed in connection with an outline of an electrolytically supplied culture system for the regeneration of breathing air using water and energy to release oxygen and absorb carbon dioxide. The problem of nitrogen regeneration for reuse in the nutrient solution is analyzed, and several experiments with species of *hydrogenomonas* are described which sought to establish whether or not these bacteria are able to use the regenerated substances.
Transl. by K.W.

N68-32142# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.
WEIGHTLESSNESS SIMULATION BY RAPID ROTATION AND ITS EFFECTS ON VARIOUS ORGANISMS [SCHWERELOSIGKEITSSIMULATION DURCH RASCHE ROTATION—IHR EINFLUSS AUF VERSCHIEDENE ORGANISMEN]
W. Briegleb *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 161–176 refs In GERMAN (See N68-32131 19-04)

Experiments are discussed which were conducted to determine the tendency of the contents of microorganisms to settle in one direction under the effect of gravity. The experiments were

performed in a rotating, oil-filled simulator. Observed were growth, shape, and any indications of deformation in tests involving *Chlorella pyrenoidosa*, cultures injected in agar-agar, on the direction of creep of strands of *Phormidium autumnale*, and on *Tribolium castaneum* eggs, larva, and adults. Transl. by K.W.

N68-32143# Max-Planck-Institut fur Biophysik, Frankfurt am Main (West Germany).
A UV RADIATION SOURCE FOR BIOLOGICAL EXPERIMENTS IN SIMULATION CHAMBERS [EINE UV-STRAHLENQUELLE FUER BIOLOGISCHE UNTERSUCHUNGEN IN SIMULATIONSKAMMERN]
W. Voelker *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 177–182 In GERMAN (See N68-32131 19-04)

The characteristics of a mercury injection lamp for the simulation of radiation effects in a biophysics laboratory are briefly described. Included are the spectra of several emissions obtained from this lamp with straight mercury injection and with additions of cadmium and a nitrogen atmosphere. Transl. by K.W.

N68-32144*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE
Cyril Ponnamperuma *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 183–195 (See N68-32131 19-04) CSCL 06C

A review is presented of experimental work which established that (1) the origin of the micromolecules or monomers, and (2) the condensation of the micromolecules into micromolecules or polymers capable of replication, could have occurred on the primordial earth before the appearance of life. The earth's primitive atmosphere and the energies available for the synthesis of organic compounds under primitive earth conditions are briefly discussed. Adenine was experimentally produced by using an electron beam to simulate potassium 40 with which methane, ammonia, and water were irradiated. Condensation reactions giving rise to polypeptides and oligonucleotides are described. K.W.

N68-32145# Max-Planck-Institut fur Biophysik, Frankfurt am Main (West Germany).
FORMATION OF AMINO ACIDS AND PEPTIDES BY RADIATION [BILDUNG VON AMINOSAEUREN UND PEPTIDEN DURCH STRAHLUNG]
K. Dose, S. Risi, and H. Rauchfuss *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 197–206 refs In GERMAN (See N68-32131 19-04)

As part of an evaluation of the concept of chemical evolution of life, the composition of the primitive atmosphere of the earth and possible sources of energy are discussed. Examples and experimental data are presented of radiochemical reactions resulting in the formation of amino acids and fatty acids and in the polymerization or condensation of amino acids to peptides and proteins. Transl. by K.W.

N68-32146# Bonn Univ. (West Germany).
BIOCHEMICAL STUDIES ON PROTEINOIDS (POLYANHYDRO-α-AMINO ACIDS) [BIOCHEMISCHE UNTERSUCHUNGEN AN PROTEINOIDEN (POLYANHYDRO-α-AMINOSAEUREN)]
G. Krampitz, T. Nakashima, S. Diehl, and W. Hess *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 207–222 refs In GERMAN (See N68-32131 19-04)

The purpose of these studies was to increase the understanding of the formation of oligopeptides or polypeptides (proteinoids) under prebiological conditions on earth. The work centered on the experimental production of synthetic polymers in the laboratory and on the characterization of these products. Composition, chemical structure, catalytic activities, and reactivity are reviewed for their role in enzymatic and metabolic processes. The use of these polymeric products as nutrients and as food for space crews is briefly considered. Transl. by K.W.

N68-32147# Max-Planck-Institut fur Biophysik, Frankfurt am Main (West Germany).
FORMATION OF NITROGEN-CONTAINING HETEROCYCLIC COMPOUNDS AFTER X-RAY EXPOSURE OF AQUEOUS SOLUTIONS OF ALIPHATIC AMINES AND AMINO ACIDS [ZUR BILDUNG VON STICKSTOFFHALTIGEN HETEROZYKLEN NACH ROENTGENBESTRAHLUNG VON WAESSRIGEN LOESENGEN ALIPHATISCHER]
E. Hussmann *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 225–233 refs In GERMAN (See N68-32131 19-04)

A post-radiation mechanism is described which leads to the formation of heterocyclic compounds. This aftereffect was observed in the irradiation of aqueous aliphatic amine or amino acid solutions when UV-spectrophotometric examinations disclosed that the extinction of the solution changed long after the irradiation had ended. However, the extinction changes only if the structure of a part of the molecules changes due to one or more chemical reactions. The experiments were conducted with a lysine solution in the presence of oxygen. The role of this aftereffect in the formation of ketones and ketone acids was studied. Fluroescence-spectrophotometric studies were performed to verify the results. Transl. by K.W.

N68-32148# Philipps-Universitat, Marburg (West Germany). Institut fuer Angewandte Physiologie.
POSSIBILITIES FOR A CONTINUOUS CONTROL OF THE HUMAN OXYGEN SUPPLY [MOEGLICHKEITEN ZUR KONTINUIERLICHEN KONTROLLE DER SAUERSTOFFVERSORGUNG DES MENSCHEN]
D. W. Luebbers *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 235–247 refs In GERMAN (See N68-32131 19-04)

Indirect methods for controlling the oxygen supply of humans are reviewed which involve measurements in the oxygen-assimilation, oxygen-transport, and oxygen-intake systems. In the oxygen assimilation system, the discussion covers control of the redox condition of the respiration ferments, the local anoxia of individual organs, the metabolite concentration in tissues, and functional disorders of organs due to hypoxia as indicated in ECG, EEG, and psychological tests. Control of the oxygen transport in the blood by continuous photometric measurements on the skin and by polarographic measurement of the oxygen pressure in the capillary areas underlying the mucosa is discussed. Control of the oxygen intake system includes measurements of the composition of inhaled and exhaled air, O_2 consumption, respiratory quotient, and monitoring of the cardio-circulatory system. Transl. by K.W.

N68-32149# Philipps-Universitat, Marburg (West Germany). Institut fuer Strahlenbiologie und Medizinische Isotopenanwendung.
ANALOG COMPUTER STUDIES AND MATHEMATICAL MODEL FOR THE REGULATORY MECHANISM OF CALCIUM METABOLISM [ANALOGRECHNER—UNTERSUCHUNGEN AN EINEM MATHEMATISCHEN MODELL ZU DEM REGULATIONSMECHANISMUS DES KALZIUMSTOFFWECHSELS]
A. Habermehl and E. H. Graul *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 249–258 In GERMAN (See N68-32131 19-04)

This study was prompted by the calcium losses observed in astronauts following their participation in space flights. The model is a quantitative expression of the regulatory mechanism for keeping the serum calcium level constant. The mathematical interrelation of the functional structure of the calcium metabolism

is outlined, and the corresponding differential equations are presented. Analog computer calculations were performed for a number of realistic abnormal situations in the calcium metabolism. Transl. by K.W.

N68-32150# Max-Planck-Institut fur Verhaltensphysiologie, Seewiesen uber Starnberg (West Germany).
THE EFFECT OF WEAK TERRESTRIAL ELECTRO-MAGNETIC RADIATION ON THE CIRCADIAN PERIODICITY OF MAN [DIE WIRKUNG SCHWACHER ELEKTRO-MAGNETISCHER STRAHLUNG IRDISCHEN URSPRUNGES AUF DIE CIRCADIANE PERIODIK DES MENSCHEN]
R. Wever *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol., and Space Med. Jun. 1968 p 259–266 refs In GERMAN (See N68-32131 19-04)

The circadian periodicity of human subjects was tested in two insulated underground bunkers, one of which was shielded against the effects of the static magnetic field. Individuals or groups were isolated in the two bunkers for periods from 3 to 6 weeks. During the period of isolation, all activities as well as temperature, urine samples, physiological, and psychological data were monitored. A tendency toward internal desynchronization was observed, and a relationship exists between activity and vegetative periodicity which appears to affect optimum performance. Recommendations are presented for the application of the findings to space travel. Transl. by K.W.

N68-32151# Max-Planck-Institut fur Verhaltensphysiologie, Seewiesen uber Starnberg (West Germany).
[INTER- AND INTRA-INDIVIDUAL DESYNCHRONIZATION IN AN IOSLATED GROUP [INTER- UND INTRAINDIVIDUELLE DESYNCHRONISATION INNERHALB EINER ISOLIERTEN GRUPPE]
E. Poeppel *In* Johann-Wolfgang-Goethe-Univ. Extraterrest. Biophys., Biol. and Space Med. Jun. 1968 p 267–274 refs In GERMAN (See N68-32131 19-04)

An experiment is described in which four male human subjects were isolated as a group for three weeks. Recorded were the periods of activity and rest, electrolyte concentration in urine, body temperature, and psychomotor tempo. Various socio-psychological tests and self-appraisals were also conducted. The spontaneous periodicity of the subjects was compared with the normal 24-hour-day rhythm, and the test data were evaluated for the ability of the individuals to live as a group. Transl. by K.W.

N68-32152# Johann-Wolfgang-Goethe-Universitat, Frankfurt Am Main (West Germany). Senckenbergisches Pathologisches Institut.
RHYTHMICAL DNA SYNTHESIS—A BIOLOGICAL PRINCIPLE [RHYTHMISCHE DNS-SYNTHESE EIN BIOLOGISCHES PRINZIP]
K. Huebner *In its* Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 275–283 refs In GERMAN (See N68-32131 19-04)

Histoautoradiography was used to study the temporal progression of compensatory and regenerative growth of tissue cells, particularly in kidneys. It was found that growth is not constant but progresses in an orderly rhythm. The temporary stoppage of blood circulation in kidneys resulted in a considerable increase in the growth rate and a steep increase in the number of DNA-synthesizing cells. Periodically recurring peaks of growth at two-day intervals were observed in experiments with mice up to 94 days in which the skin of the mice was brushed with methylcholantrene. The cause for the rhythmic DNA synthesis remains unknown. Transl. by K.W.

N68-32153# Philipps-Universtitat, Marburg (West Germany). Institut fuer Arbeitsphysiologie und Rehabilitationsforschung.
RHYTHMOLOGICAL PROBLEMS OF AEROSPACE MEDICINE [RHYTHMOLOGISCHE PROBLEME DER RAUMFAHRTMEDIZIN]
G. Hildebrandt, P. Engel, and E. D. Voigt *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun 1968 p 285–303 refs In GERMAN (See N68-32131 19-04)

Test results and diagnostic findings are reviewed of numerous works related to the rhythmological aspects of space flight. Among the subjects covered are isolation experiments, desynchronization, disturbances of frequency and phase coordination, the circadian rhythm, and sleep–wake cycles, also discussed are factors affecting the metabolic and excretory functions, adaptation, and the capacity for physical work. Transl. by K.W.

N68-32154# Air Force European Central Aeromedical Services, Wiesbaden (Germany).
A PHYSIOLOGICAL SYSTEMS ANALYSIS OF STRESS-INDUCED TEMPORARY EYE MUSCLE DISORDER AND ITS SIGNIFICANCE FOR AEROSPACE TRAVEL [EINE PHYSIOLOGISCHE SYSTEMANALYSE VON STRESS INDUZIERTER VORUEBERGEHENDER AUGENMUSKELSTOERUNG UND DEREN BEDEUTUNG IN DER LUFT- UND RAUMFAHRT]
Leonard Michael Fenning *In* Johann-Wolfgang-Goethe-Univ. Extraterrest., Biophys., Biol. and Space Med. Jun. 1968 p 305–318 refs In GERMAN (See N68-32131 19-04)

The effects of rapid changes in atmospheric pressure, acceleration in three axial directions linearly and radially, hypoxia, fatigue, alcohol, and emotional stress on the visual performance of pilots are investigated. The interrelation of these stress factors with phoria changes and connections between blood pressure and phoria are clarified in a hypothetical physiological system analysis. Results are also presented of experimental studies in pressure chambers on the causes of phoria changes. Transl. by K.W.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-31101*# General Dynamics/Convair, San Diego, Calif.
EFFECT OF INSTABILITY DURING ROTATION ON PHYSIOLOGIC AND PERCEPTUAL-MOTOR FUNCTION Final Report
Jun. 1968 100 p refs
(Contract NAS9-6986)
(NASA-CR-92211; GDC-DBD67-002-12) CFSTI: HC $3.00/MF $0.65 CSCL 05H

A rotogravity environment has been studied on the basis of radius requirement and rotational velocity limitations for crew habituation and performance. The effect of perturbation during rotation is the subject of this study. Investigated is the effect of rotation and sinusoidal perturbation on a seated subject performing a battery of perceptual-motor tests representative of the tasks required by an astronaut crew with the added factor of a rapid head motion upon the perturbating environment at high rates of rotation. The criteria were performance of an eye–hand response test and the time it took for the subject to fixate on a point display following the head turn. The perturbation affects on the time it took for the habituation of a single perceptual element to rotation and the disorientation that results from a rapid head motion is evaluated by the "Oculogyral Illusion" that occurs in a darkened room. An illuminated target appears to drift about and this motion is extinguished as habituation occurs. Results indicate that sinusoidal motions of the magnitude anticipated in space stations should not complicate the performance of crew tasks that do not require the translation of a subject in that environment. Author

N68-31149# George Washington Univ., Alexandria, Va. Human Resources Research Office.

A CONCEPT OF THE ROLE OF MAN IN AUTOMATED SYSTEMS

William H. Melching May 1968 11 p refs Presented at the Southwestern Psychological Assoc. Ann. Meeting, New Orleans, Apr. 1968 /ts Profess. Paper 14–68

(Contract DA-44-188-ARO-2)

(AD-671128)

A problem that has long plagued system designers and human factors engineers is that of allocation of functions between man and machine. This paper reports an attempt to isolate and identify factors pertinent to making allocation decisions. From an analysis of the functions and missions of several automated systems, six factors were shown to be highly relevant to allocation decisions. One factor, mans role in automated systems, emerged as a variable of particular interest. In addition, four classes of manual functions common to all automated systems were identified. It was determined that these classes, in turn, constituted a meaningful description of the role of man in todays automated systems. Author (TAB)

N68-31184# Naval School of Aviation Medicine, Pensacola, Fla.

THE RELATIONSHIP OF THE NAVAL AVIATOR'S SPEECH DISCRIMINATION TEST TO THE PURE TONE AUDIOGRAM

James W. Green Apr. 1968 21 p refs

(NAMI-1037; AD-671188)

The pure tone threshold audiogram required annually for naval aviators provides limited information toward determining their ability to understand speech in the aircraft. The Naval Aviators Speech Discrimination Test (NASDT) was developed to evaluate objectively the ability to understand very loud speech in a background of aircraft noise for those aviators whose hearing failed to meet the standards. An earlier study had indicated that there was no relationship between the results of the NASDT and the configuration of the pure tone audiogram; therefore, to further examine this finding, data from pure tone threshold tests and the NASDT were obtained for over 500 men with different degrees of flight experience. Statistical analysis of the NASDT results showed that there was great consistency in scores made by the different groups. No practical correlations between NASDT scores and hearing threshold levels were found. Since the NASDT, therefore, appears to provide a more realistic evaluation of hearing in aircraft noise, it is suggested that it be employed as a supplementary test in the hearing evaluations of all aviators. Author (TAB)

N68-31190# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

THE EFFECTS OF HIGH INTENSITY NOISE ON HUMAN PERFORMANCE Final Report, Oct. 1966–Jan. 1967

C. Stanley Harris Jan. 1968 25 p refs

(AMRL-TR-67-119; AD-671116)

Four experiments were conducted on the effects of broadband, high intensity noise on human performance. In two experiments the subjects performance was measured on a Discrimination Task, based primarily upon visual discrimination and short term memory, and in the other two experiments performance was measured on a Hand-Tool Dexterity Test. Four different noise exposure conditions were used in each experiment: control (70 dB), 120 dB, 130 dB, and 140 dB (re 0.0002 dyne/sq cm). In one experiment using the Discrimination Task, the subjects wore earplugs, and in the other, subjects wore earplugs and an earmuff with one earcup to produce an asymmetrical noise exposure at the ears. These two types of ear protectors were worn also by the subjects in the two experiments using the Hand-Tool Dexterity Task. Decrements on the Discrimination Task were obtained at the two highest noise intensities for the asymmetrical exposure and no decrements were obtained for any symmetrical exposure. With the Hand-Tool Dexterity Test, significant decrements were obtained at the noise levels of 130 dB and 140 dB with symmetrical exposure, and at 140 dB with the asymmetrical exposure. The difference in performance between the two groups was due to a different initial level of ability on the task rather than due to symmetrical versus asymmetrical exposure conditions. The results indicate that asymmetrical exposure had a greater detrimental effect on the Discrimination Task than the symmetrical exposure, while there was no differential effect on the Hand-Tool Dexterity Test. These results are discussed as a possible effect of the action of high intensity noise on the vestibular system. Author (TAB)

N68-31243*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

A STUDY TO ANALYZE THE DEVELOP DESIGN CRITERIA FOR A FLIGHT-CONCEPT PROTOTYPE VAPOR DIFFUSION WATER RECLAMATION UNIT Final Report, Apr. 1967–Apr. 1968

Henry Kolnsberg and Melvin Stoltz 19 Jul. 1968 84 p refs

(Contract NAS1-7170)

(NASA-CR-66637) CFSTI: HC$3.00/MF$0.65 CSCL 05E

A vapor diffusion water reclamation system was studied for the purpose of defining the design parameters for a flight-concept prototype. A mathematical model of the vapor diffusion process was formulated and verified by experimentation. Among the variables studied were recirculation flow rate, differential temperatures, gap width, gap gas composition and pressures. It was found that the overall vapor diffusion rate varies significantly only with the nature of the membrane, the gap width, and the gap gas composition. Author

N68-31303# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIOELECTRONIC EQUIPMENT FOR TEMPORAL ANALYSIS OF REFLEXES

Ya. O. Bodser and M. I. Klevtsov Jul. 1967 77 p refs Transl. into ENGLISH of the book "Radioelektronnaya Apparatura Dlya Uremennogo Analiza Refleksov" Moscow, 1964 p 1–64

(FTD-MT-66-133; AD-670948)

Chapters of this report are devoted to the following aspects: (1) Reflexes, their significance and analysis. (2) Basic elements of radioelectron equipment for temporal analysis of reflexes. (3) Regular production and experimental models of instruments for measurement of reflexes. (4) Radioflexometry. Author (TAB)

N68-31363# Bell Aerosystems Co., Buffalo, N. Y.

THE INFLUENCE OF NETWORK STRUCTURE ON THE PERFORMANCE OF LEARNING SYSTEMS

Johannes G. Goerner, Lester A. Gerhardt, Kenneth W. Drake, James A. Cadzow, and Frederic D. Powell 31 Oct. 1967 92 p refs

(Contract AF 49(638)-1627)

(Rept.-9500-920089; AFOSR-68-1350; AD-670845)

The report summarizes research on means for improving the discrimination capability of linear single-gain layer networks. Improvements are considered via (a) nonlinear pre-processors, such as the A/D converter, the quantizer, and other encoders; the generation of functionals of the individual pattern components, and (b) cascading of these networks. All result essentially in introducing a nonlinear decision surface instead of the decision hyperplane as defined by a linear net. Significant improvements are obtainable that widen the application of such networks to practical problems. As an example, the modeling of an air cushion vehicle is discussed. Author (TAB)

N68-31387# Naval Personnel Research Activity, San Diego, Calif.

AN EXPERIMENT IN BASIC AIRBORNE ELECTRONICS TRAINING. PART 5: EVALUATION OF THE REVISED COURSES

Robert O. Baldwin and Kirk A. Johnson Jun. 1968 21 p refs

(NPRA-STB-68-10; AD-671185)

This is the fifth in a series of studies on shortened versions of the Avionics Fundamentals and Aviation Electronics Technician R (Radar) Courses. The first four studies indicated that the initial revisions of the courses led to substantial savings in training time, but that the graduates from the revised courses were slightly inferior to graduates from the original courses on several criteria. It was decided that shortened versions of both courses should be implemented on an operational basis, but that these courses should incorporate certain changes that had been suggested by experience with the first revisions. These changes led to courses that were not quite as short as those produced in the first revision. The current study is an evaluation of the second revisions. Author (TAB)

N68-31396# School of Aerospace Medicine, Brooks AFB, Tex.
MEASURING THE RADIOFREQUENCY FIELD STRENGTH OF IMPLANTED TRANSMITTERS Final Report, Sep. 1966–Feb. 1967
Henry Buchanan, Jere M. Phillips, Willis F. Moore, and Calvin R. Richter Mar. 1968 15 p refs Submitted for publication
(SAM-TR-68-33; AD-670516)

Radiofrequency (RF) signal strength measurements were made of small VHF transmitters in free-space and after abdominal implantation in rhesus monkeys. This was done to determine the extent to which RF energy is absorbed by the body tissue. All measurements were made in the 84 to 106 MHz frequency range using both horizontally and vertically polarized receiving antennas. Sixteen implants were evaluated in twelve animals. Data are presented in polar coordinate form giving distribution patterns of radiation field strength before and after implantation. Most of the transmitters showed only signal attenuation after implantation and no modification of field pattern. This indicated body tissue is transparent to 84 to 106 MHz electromagnetic energy. Author (TAB)

N68-31447# Library of Congress, Washington, D. C. Aerospace Technology Div.
ENGINEERING PSYCHOLOGY Surveys of Foreign Scientific and Technical Literature, 1966–1967
Alan Campbell 5 Jun. 1968 96 p refs
(ATD-68-34-108-2; AD-670510)

Contents: Problems in the education and training of scientific and technical personnel in the Soviet Union; Problems in the training of military personnel; Human operator performance; Instrumentation, configuration, and design; Group dynamics; Personnel selection and training; Measurement of aptitudes and other psychological characteristics; Pedagogy and programmed learning; Use of simulators and other training devices. TAB

N68-31454# Antioch Coll., Yellow Springs, Ohio.
ANTHROPOMETRY OF THE HUMAN EAR. A PHOTOGRAMMETRIC STUDY OF USAF FLIGHT PERSONNEL
Milton Alexander (AMRL) and Lloyd L. Laubach Wright-Patterson AFB, Ohio AMRL Jan. 1968 36 p refs
(Contracts AF 33(615)-1101; F33615-67-C-1310)
(AMRL-TR-67-203; AD-670869)

A technique was developed that enables precisely specified ear dimensions to be measured directly from PhotoMetriC slides. Summary statistics for each of the various ear dimensions are presented for a sample of 500 subjects randomly chosen from a total series of 2236 photographic slides collected during the 1957 Authropometric Survey of USAF Male Flying Personnel. Regression equations for predicting the various ear dimensions from Ear Length and Ear Breadth are presented. A complete intercorrelation matrix for all variables studied in this research is also shown. The reliability and objectivity of the technique are discussed. Author (TAB)

N68-31480*# Biotechnology, Inc., Arlington, Va.
EFFECT OF HEAT STRESS AND PROLONGED ACTIVITY ON PERCEPTUAL-MOTOR PERFORMANCE
Raymond E. Reilly and James F. Parker, Jr. Washington NASA Aug. 1968 58 p refs
(Contract NASw-1329)
(NASA-CR-1153) CSCL 06S

This study was concerned with the assessment of the effects of two stress conditions on 16 basic dimensions of perceptual-motor performance. Subjects were tested under conditions of heat stress (86°F effective temperature for a period of six hours) and prolonged activity (24-hour continuous activity, with two 2-hour rest periods). In general, perceptual-motor performance levels were well maintained under these stress conditions and there was essentially no change in performance effectiveness during the 24-hour period of prolonged activity. Under heat stress, oral temperature and pulse rate increased significantly, lending support to the inference of increased arousal. Under prolonged activity, no change was noted in oral temperature, pulse rate, or blood pressure. This was consistent with the general lack of change in the performance measures indicating this level of stress was well tolerated. The findings of this investigation demonstrate the usefulness of the integrated measurement system as a device for the study of human performance. Author

N68-31496# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IDENTIFICATION OF IMAGES [OPOZNAVANIYE IZOBRAZHENIY]
V. S. Fayn 12 Sep. 1967 24 p Transl. into ENGLISH from Priroda (Moscow), no. 2, 1966 p 18-26
(FTD-MT-66-158; AD-671204)

An introductory discussion of a machines ability to identify images and respond to them in a manner similar to human behavior which is essentially a response to visual image identification. The need for such machine capability is evident when speed, accuracy, or volume of information is beyond human ability or when the information is located in places inaccessible to humans. Visual perception by a machine involves an infinity of manifestations. The machine must memorize every presented realization of a given class of objects and all other needed classes. The machine must memorize because it cannot learn to identify, but this requires an infinite memory which is impossible for a machine. Hence the field of the automaton is limited to identifying regularities of images. Constant images, such as letters, are easy for the machine to identify. However, the problem of moving images, such as human faces, is more complex. Solution of such a problem can lead to solving other problems not related to images, e.g., identifying sounds of speech. TAB

N68-31511# Joint Publications Research Service, Washington, D. C.
THE FEEDING OF COSMONAUTS IN SPACE FLIGHT
N. Radchenko 26 Jul. 1968 5 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 6, Jun. 1968 p 59–62
(JPRS-46002)

Food rations for space flights are discussed in general terms, and mention is made of diets consumed by cosmonauts and astronauts on previous manned flights of short duration. Nourishment and weight requirements of foodstuffs for flights of longer duration are noted, as is the determination of suitable species of algae, higher plants, and animals for use in a closed ecological system. M.W.R.

N68-31583# George Washington Univ., Alexandria, Va. Human Resources Research Office.
LEARNING THEORY AND RESEARCH PARADIGMS APPLIED TO TRAINING RESEARCH: SOME DISSONANCES
Eugene F. Mac Caslin and Eugene A. Cogan May 1968 9 p ref Presented at the Am. Psychological Assoc. Conv., Los Angeles, Sep. 1964 *Its* Profess. Paper 13-68
(Contract DA-44-188-ARO-2)
(AD-671060)

While the problems and methods of learning theory and training technology seem similar, they are in fact subtly different. Illustrations of dissonance are discussed, using the following natural but inefficient extrapolations from academic traditions: to test a training program, compare two candidate programs; to compare two training devices, hold SS, training time, and method constant; the problem of a training program is a special case of transfer of training; a single objective task analysis may be used for any of several research purposes; and training methods for psychomotor performance and sensory discrimination are the best investment of training research. Author (TAB)

N68-31686# Arizona State Univ., Tempe.
A STUDY TO DETERMINE THE FEASIBILITY OF ESTABLISHING A NATIONAL PROGRAM FOR TRAINING SKILLED AVIATION PERSONNEL
Jul. 1967 33 p refs Prepared in cooperation with Office for Economic Development, Washington, D. C.
(PB-178076) CFSTI: HC $3.00/MF $0.65

The growth picture is based partly on the fact that aviation technology is, today, on the threshold of significant advances in a number of areas. These developments will open new passenger and airfreight markets and will result in significant increases in personal flying, as well as in productivity in commercial service. The increase in numbers and complexity of aircraft will also generate requirements for greater numbers of more highly skilled personnel. At a time when aviation is entering its greatest period of growth, a critical problem has developed with respect to availability of highly skilled personnel, particularly pilots and mechanics. This problem has been developing slowly since 1960. Author (USGRDR)

N68-31734# California Univ., Los Angeles. Dept. of Engineering.
AN ADAPTIVE APPROACH TO OPTIMUM SWITCHING CONTROL OF ARTIFICIAL ARMS
Amos Freedy, Luigi F. Lucaccini, and John Lyman Aug. 1967 22 p refs
(Contract V1005P-9779)
(TR-43; Rept.-67-47; PB-177824) CFSTI: HC $3.00/MF $0.65

The problems involved in adapting a 'bang-bang' switching system for control of an externally-powered artificial arm are considered. Stability problems of the 'bang-bang' system were solved by designing and constructing an adaptive self-stabilizing subsystem. The overall system was simulated on an analog computer for control of one-dimensional movements. In a pilot study four subjects using manual control demonstrated that the system would reach stable operation. Author (USGRDR)

N68-31791# Federation of American Societies for Experimental Biology, Washington, D. C.
ANALYSIS OF FUNCTIONAL ORGANIZATION OF CONDITIONED AVOIDANCE REFLEXES
R. L. Gasanova [1968] 25 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti Im. I. P. Pavlova (Moscow), v. 17, no. 3, 1967 p 451–458 In ENGLISH and RUSSIAN
(NS-59; PB-178055T) CFSTI: HC $3.00/MF $0.65

The object of investigation was the functional structure of temporary connection in avoidance reactions in dogs, namely, lifting the left foreleg, up to a definite height, first elaborated to electric stimulation of the right hindleg, and then to a distant conditioned stimulus. Four experimental series with extinction of the reaction were carried out: (1) with elimination of electrical stimulation; (2) in the course of elaboration of a similar reaction of the other leg; (3) extinction with reinforcement, when the elaborated movement did not relieve the dog of the current; (4) extinction of avoidance reaction of the foreleg, induced by direct electrical stimulation of the hindleg. Author (USGRDR)

N68-31793# System Development Corp., Dayton, Ohio.
HUMAN FACTORS DATA THESAURUS (AN APPLICATION TO TASK DATA) Final Report, 2 Jan.–31 Oct. 1967
Robert G. Oller Wright-Patterson AFB, Ohio AMRL Mar. 1968 71 p refs
(Contract F33615-67-C-1036)
(AMRL-TR-67-211; AD-670578)

This report describes how vocabulary and thesaurus techniques can be applied to a user-oriented computerized data handling system. An analysis is presented of the specialized problems associated with the development of vocabularies and rules for regulating their usage. The content of the report consists of glossaries of action verbs and nouns accompanied by appropriate rules of usage and cross-reference indexes of acceptable terms and their synonyms. All the terms contained in the vocabularies are clearly defined and are mutually exclusive. Care was exercised to avoid selecting terms that had restricted usage, so they would be useful in a wide range of aerospace systems. Consistency in meaning of terms and rules governing their usage will reduce confusion when indexing data and help maintain the users confidence in the data retrieved. The vocabularies and rules for usage should, with modifications, be applicable to any data base containing aerospace human factors data. Only limited additions should be required to the verb glossary to express any human actions associated with aerospace systems. Author (TAB)

N68-31808# School of Aerospace Medicine, Brooks AFB, Tex.
AN AUTOMATIC SYSTEM FOR THE INDIRECT DETERMINATION AND RECORDING OF HUMAN ARTERIAL BLOOD PRESSURE
James D. Rogge, William K. Brown, and Clay A. Brown Mar. 1968 20 p refs
(SAM-TR-68-25; AD-670515)

An automatic system for the indirect determination of human arterial blood pressure, as used in the Biodynamics Branch, USAF School of Aerospace Medicine, is described and compared with direct methods of measurement. The pressures recorded from the brachial artery by this system are not significantly different from direct measurements of arterial pressure obtained simultaneously. This degree of accuracy is probably related, in part, to the placement of the microphone under the upper half of the blood pressure cuff. With proper positioning of the microphone and the appropriate use of filters, the system will produce records free of artifact in the presence of environmental noise and vibration. This capability makes it useful in dynamic environments where the determination of arterial blood pressure is necessary. Author (TAB)

N68-31875# Task Group DELTA, Norfolk, Va.
A SYNOPTIC VIEW OF THE NEED FOR VP AIRCREW MEMBER TRAINING OPTIMIZATION
May 1968 25 p refs
(DELTA-22; AD-670755)

The report outlines the need for clarification of the relationship between current and future aircrew training programs and performance requirements in patrol squadrons. It is proposed that a contract be granted for the review of all training phases of squadron aircrew personnel and of means to optimize this training. Author (TAB)

N68-31881# Purdue Univ., Lafayette, Ind.
INCREASING FAILURE AND RESPONSE RATE IN COMPLEX DECISION MAKING

Siegfried Streufert May 1968 23 p refs
(Contract N00014-67-A-0226)
(TR-12; AD-670749)

The effect of increasing failure on response rate and its components in complex decision making was investigated. Data were collected in a simulated decision-making environment permitting integrated, retaliatory, and general unintegrated decision making by dyads. It was found that (1) integrated decision making first increases and then decreases as the failure levels of information which groups experience are increased; (2) general unintegrated decision making increases when failure reaches moderate levels; and (3) retaliatory decision making is not affected by failure induction. The total decision-making response rate generally follows the characteristics of the curve for the integrated decision-making component, although it is, of course, somewhat higher.

Author (TAB)

N68-31891# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ON THE PSYCHOLOGICAL IMPORTANCE OF TIME IN A TIME SHARING SYSTEM
Jaime R. Carbonell, Jerome I. Elkind, and Raymond S. Nickerson Sep. 1967 30 p refs
(Contract F19628-68-C-0125; ARPA ORDER-627)
(BBN-1687; AFCRL-68-0120; SR-6; AD-670604)

One of the most important problems in the design and/or operation of a computer utility is to obtain dynamical characteristics that are acceptable and convenient to the on-line user. This report is concerned with the problems of access to the computer utility, response time and its effect upon conversational use of the computer, and the effects of the load on the system (and its fluctuations) upon the other aspects. Primary attention is placed upon response time. Some of the difficulties in its definition are pointed out through examination of the typical interaction process. It is concluded that rather than a single measure a set of response times should be measured in a given computer utility, in correspondence to the different types of operations requested. Next, it is tentatively assumed that the psychological value of short response times stems from a subjective cost measure of the users own time, largely influenced by the value of concurrent tasks being postponed. A measure of cost (to the individual and/or his organization) of the time-on-line required to perform a task might thus be derived. More subtle is the problem of the users acceptability is a function of the service requested (e.g., length of computation), and variability with respect to expectations due both to uncertainty in the users estimation and to variations in the response time originated by variable loads on the system. Author (TAB)

N68-31911*# Massachusetts Inst. of Tech., Cambridge.
A THEORY AND MODEL OF HUMAN LEARNING BEHAVIOR IN A MANUAL CONTROL TASK
Albert Ernest Preyss Washington NASA Aug. 1968 138 p refs
(Grant NsG-577)
(NASA-CR-1124) CFSTI: HC $3.00/MF $0.65 CSCL 05H

A theory is presented for the explanation of human learning behavior in a manual control task. In the performance of a psychomotor task, a human operator responds to sensory stimuli with limb movements. This psycho-physiological phenomenon is conceptualized herein as a single channel information processing system. A sensor, a decision center and an effector are the serially connected components of the system. In the decision center responses are selected from a set of possible alternatives. Stored in memory are apriori estimates of the probability that a specific response should be inforced at the moment of decision. Response selection is determined by a rule which takes the priors into account. Learning is effected by a revision of the priors based on the weighting of certain evidence. The model of human learning behavior is a computer program obtained from a translation of the theory into machine language. Model behavior is compared with subject behavior measured in a motor skill experiment performed at M. I. T.'s Man Vehicle Laboratory. Author

N68-31925# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
MONAURAL LOUDNESS FUNCTIONS UNDER MASKING
Alan M. Richards 14 Feb. 1968 13 p refs
(SMRL-509; AD-670756)

Monaural sone functions are obtained for a no-noise condition and under five levels of masking noise, using the method of fractionation. This method precludes the use of both ears in obtaining such functions as has been the case with dichotic loudness balance, and other related procedures. The obtained curves are found to parallel previously found masked functions in one case, and in another to show a more rapid acceleration at low levels, but identical slopes above one sone. When the power function exponent of a 100-Hz tone is plotted against overall SPL of a masking noise, a power transformation is obtained, which parallels that found for speech-in-noise. Although no numerical calculations are presented, it appears that, above 60 dB of noise, the exponent grows as approximately the 0.16 power of the noise. Author (TAB)

N68-32034# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NUMBER 8 Monthly Review of Selected Foreign Scientific and Technical Literature
Aug. 1968 42 p refs

CONTENTS:

1. THE PRESENT STATUS OF RESEARCH IN TELEPATHY IN THE SOVIET UNION V. Mutschall p 1–12 refs (See N68-32035 19-05)

2. RECENT SOVIET EXPERIMENTS IN TELEPATHIC COMMUNICATION I. Velinov p 13–23 refs (See N68-32036 19-05)

N68-32035# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE PRESENT STATUS OF RESEARCH IN TELEPATHY IN THE SOVIET UNION
Vladimir Mutschall *In its* Foreign Sci. Bull., Vol. 4, No. 8 Aug. 1968 p 1–12 refs (See N68-32034 19-05)

The methods and results of early and recent Soviet theoretical and experimental research in telepathy are reviewed. Author

N68-32036# Library of Congress, Washington, D. C. Aerospace Technology Div.
RECENT SOVIET EXPERIMENTS IN TELEPATHIC COMMUNICATION
Ivan Velinov *In its* Foreign Sci. Bull., Vol. 4, No. 8 Aug. 1968 p 13–23 refs (See N68-32034 19-05)

Recent Soviet experiments in telepathic communication are described and the results are analyzed by using methods and techniques within the framework of the information and communication theories. Author

N68-32043# Virginia Polytechnic Inst., Blacksburg.
THE EFFECT OF RANDOM INTERNAL MOTIONS ON THE ANGULAR ORIENTATION OF A FREE BODY WITH LIMIT CONTROL
John R. Davidson (Ph.D. Thesis) May 1968 92 p refs

The equations of motion for the spacecraft are solved to obtain a simple relationship between individual crew motions and the angular change in spacecraft orientation. For the majority of manned spacecraft, the angular changes about the three principal axes of inertia can be considered independent. The additive effect of many motions, considered random in frequency and magnitude, is found by treating the motion as a form of random walk. Solutions are obtained from the time required to reach predetermined maximum allowable angular deviation limits. If reaction control jets are used for stabilization, this time determines the frequency of firing and the fuel consumption rate. For relatively heavy spacecraft,

the complete solution to the diffusion equation gives the time between control jet firing; this solution has a particularly simple form. For smaller spacecraft, where individual motions may cause a change in orientation which is several percent of the maximum allowable, additional solutions have been obtained using Markov chain matrix analysis. Author

N68-32078# Rockford Research Inst., Inc., Cambridge, Mass.
INDUCTIVE INFERENCE RESEARCH STATUS, SPRING 1967 Final Report
Raymond J. Solomonoff 1 Jul. 1967 70 p refs
(Grant AF-AFOSR-464-65)
(RTB-155; AFOSR-68-1283; AD-670907)

Prior research on four theories of inductive inference are brought current in the present report with informal demonstrations of the likelihood of their equivalence that provide a firmer theoretical foundation for them. Initial work dealt with prediction of discrete time series. A fairly easily generalized result is presented of the application of these methods to continuous phenomena. A minimal criterion is given that any model of induction must satisfy; the proposed models of induction appear to be the only ones that satisfy this criterion. The uncomputability of the induction methods, which is related to the unsolvability of the halting problem, is a necessary consequence of their satisfying this criterion. A general formalism for the task net problem is devised in which known heuristic search problems may be formulated, but the adequacy of the formalism remains to be tested. The applicability of induction theory to man-to-animal communication is discussed briefly. Author (TAB)

N68-32100*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A SIMPLE LABORATORY METHOD FOR REDUCTION OF RHYTHM AND RATE IN LARGE-SCALE MONITORING OF ELECTROCARDIOGRAM
James Roman, Fred M. Larmie (Northrop Corp., Edwards, Calif.), and Tulio R. Figarola (Lovelace Found., Edwards, Calif.) Washington Aug. 1968 15 p refs Prepared in cooperation with Northrop Corp. and Lovelace Found. Field Teams at Edwards, Calif.
(NASA-TN-D-4751) CFSTI: HC $3.00/MF $0.65 CSCL 06B

A laboratory system for rapid reduction of large amounts of continuously recorded ECG information has been developed. The system consists of 60-times-real-time playback device which generates one pulse for each cardiac cycle, appropriate signal conditioning and logic circuitry, and a counting and printing system. Practical means for culling out noisy information, at 60 times real time, are provided. In addition, modifications to the commercially available parts of the system have been made that significantly increase the reliability of diagnosis of ectopic events by the average investigator. Author

N68-32163*# North American Rockwell Corp., Downey, Calif. Space Div.
A STUDY OF MISSION DURATION EXTENSION PROBLEMS Summary Report, 1 Oct. 1966–1 Oct. 1967
Roy B. Carpenter, Jr. 15 Dec. 1967 44 p
(Contract NAS2-4214)
(NASA-CR-73239; SID-67-478-4, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Characteristics, constraints, and implications of extended duration space missions were investigated by applying an availability concept to mission/system design. Feasibility of this availability concept was demonstrated, and it was found that much of the required hardware is already available and nearly qualified. The operational concept is considered to exert a pronounced influence on mission success and crew safety. Maintenance and repair in space was found to be both feasible and desirable, and unscheduled maintenance and repair work load requirements to support critical systems are considered to be low. Chance of extravehicular maintenance action is expected to be less than 1 in 1000, and chance of more than 260 maintenance and repair actions during a two-year period expected to be less than 1 in 100. Spares weight decrement for unscheduled maintenance is estimated at about 900 lb. The module/assembly is considered the optimum level for most maintenance and replacement actions, and required maintenance can be accomplished within expected downtime constraints. M.W.R.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-30866 Joint Inst. for Nuclear Research, Dubna (USSR).
CHEMICAL PROPERTIES OF ELEMENT 104 [KHIMICHESKIYE SVOYSTVA ELEMENTA 104-KURCHATOVIYA]
I. Zvara, Yu. T. Chuburkov, R. Tsaletka, M. R. Shalayevskiy, T. S. Evarova et al *In its* Rept. of the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 19–32 refs In RUSSIAN (See N68-30864 19-24)

The properties of the element 104 are compared with those of Zr and Hf. Carrier-isotope combinations were studied in model experiments involving bombardment with known elements. Detection efficiency, half-life, losses due to radioactive decay, and temperature effects are discussed. The suitability of chlorides as carrier elements was investigated. The number of decay events detected in chemical experiments was considerably smaller than in physical experiments. Transl. by K.W.

N68-30877 Newark Coll. of Engineering, N. J.
KINETICS OF HYDROGEN REDUCTION OF MANGANESE DIOXIDE
Herbert Eugen Barner (D. Eng. Sc.) 1967 179 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-14246

Samples of synthetic pyrolusite were reduced in hydrogen at various partial pressures in the temperature range of 200° to 500°C. Most reduction experiments were conducted using a Pyrex vertical-tube reactor, in which small beds of porous particles (0.07 to 0.21 mm.) or single porous pellets of the oxide were suspended. The reaction kinetics were followed by recovering and weighing the water product formed during measured time intervals, and the intermediate reduction products were identified by X-ray diffraction analysis. The data show that reduction proceeds through the sequence $MnO_2 \rightarrow Mn_2O_3 \rightarrow Mn_3O_4 \rightarrow MnO$. Below 250°C no MnO was detected, and the reaction practically terminated with the formation of Mn_3O_4. Above 250°C the Mn_3O_4 became progressively more protective, and the reduction of Mn_3O_4 to MnO became appreciable. Above 300°C all four oxides were detected in the partially reduced products, although the MnO_2 and MnO phases were usually the major components. Dissert. Abstr.

N68-30878 Michigan State Univ., East Lansing.
SEPARATION OF POLAR AND NON-POLAR MOLECULES IN A NON-UNIFORM ELECTRIC FIELD
Charles Douglas Beals (Ph.D. Thesis) 1967 186 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-14472

A theoretical and experimental investigation of the dielectrophoresis of dilute aqueous solutions of polymethacrylic acid in a separation cell with cylindrical geometry was undertaken in this study in order to examine the feasibility of using the dielectrophoretic effect as a separation technique. Analysis of the forces acting on a dipolar molecule in an A.C. or D.C. non-uniform

electric field shows that the molecule will migrate in the direction of highest field strength. Solution of the transport equations describing the system yields equilibrium temperature, velocity, and concentration profiles as a function of radial position. The equilibrium separation factor or ratio of top to bottom cell concentration is found from the radial concentration profile. The theoretical separation factor is found to increase with increasing cell length, applied voltage, and molecular polarizability and to decrease with increasing values of the ratio of the outer to inner cylinder radii. Dissert. Abstr.

N68-30882 City Coll. of the City of New York.
THE INFLUENCE OF OXYGEN ON THE REACTIONS OF RECOIL CARBON ATOMS WITH SATURATED HYDROCARBONS AND GENERALIZED DESCRIPTIONS OF PRODUCT YIELDS FROM THE REACTIONS OF ENERGETIC CARBON ATOMS WITH SATURATED HYDROCARBONS IN OXYGEN-SCAVENGED SYSTEMS
Peter Lieberman 1967 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-12563

The reactions of carbon atoms of high translational energy ("hot" carbon atoms) with saturated hydrocarbons in the presence of oxygen have been investigated. The reaction system is generated by bombarding the gaseous hydrocarbon-oxygen substrate mixture with nuclear particles, inducing the $^{12}C(n,2n)^{11}C$ reaction or the $^{12}C(p,pn)^{11}C$ reaction in an infinitesimal fraction of the carbon atoms. The converted atoms recoil at high energy, breaking their chemical bonds. The high kinetic energy of the atoms is degraded in collisions with the substrate molecules until energies are low enough for reactions to give stable chemical species. Products containing the recoil nuclide are labelled because ^{11}C is radioactive. Radio-gas-chromatography is used to separate and assay the products. Dissert. Abstr.

N68-30889 Wisconsin Univ., Madison.
STRUCTURAL CHEMISTRY OF THREE TRANSITION METAL COMPLEXES
Steven F. Watkins (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-9025

The crystal and molecular structures of three transition metal complexes. $[C_5H_5Cr(SCCF_3)_2]_2$, $(C_5H_5)_2$ $Ti(SC_6H_5)_2$, and $[P(C_6H_5)_3]_2$ Rh(CO)Cl, have been determined from three-dimensional single-crystal X-ray structural analyses. The structural determination of $[C_5H_5Cr(SCCF_3)_2]_2$ was undertaken in order to study the coordianation of the unusual bidentate ligand *bis*-(trifluoromethyl) ethylene-*cis* dithiolate. The complex crystallizes with four dimeric molecules in a monoclinic ·unit cell of space group symmetry C2/c and dimensions a = 16.97 Å, b = 10.57 Å, c = 12.85 Å, and $\beta = 93°04'$. The unexpected molecular configuration observed can be described as the juxtaposition of two octahedra at a common edge with each of the $S_2C_4F_6$ ligands contributing one bridging sulfur atom, while the other sulfur of each ligand is bonded to a single chromium atom. The remaining three octahedral coordination sites about each metal are occupied by a cyclopentadienyl ring. The chromium-chromium distance is found to be 2.99 Å. Dissert. Abstr.

N68-30892 Alfred Univ., N. Y. Coll. of Ceramics.
THE INFRARED SPECTROSCOPY OF THE CARBONATE RADICAL
Richard M. Klein (Ph.D. Thesis) 1967 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12034

Selection rules for fundamentals, first overtones and binary combination bands in calcite and aragonite are derived using the site group approximation. Correlation with single crystal spectra of these materials indicates that the approximation is valid in these cases. KBr and ATR powder spectra of calcite, aragonite barium carbonate and sodium nitrate are taken before and after grinding for various times up to 30 minutes. The effectiveness of the grinding is deduced from surface area determinations. The ATR spectra of the carbonates undergoes a shift to lower frequencies and a change in band shape with increasing grinding times. Similar changes of smaller magnitude are found in the KBr spectra of aragonite and barium carbonate. These spectral alterations are shown to be caused by the change in crystal field strength which accompanies lattice distortions induced by grinding. Dissert. Abstr.

N68-30894 Illinois Univ., Urbana.
AN APPLICATION OF EXTENDED HUCKEL THEORY TO ELECTRON DENSITY DISTRIBUTION IN OPEN AND CLOSED SHELL MOLECULAR SYSTEMS
Harold Petersen, Jr. (Ph.D. Thesis) 1967 179 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-11900

An investigation has been carried out using Extended Huckel Theory with iteration to charge consistency to test the hypothesis that the theory can be used to predict electron density distributions in molecular systems. The following molecular systems were considered: benzonitrile negative ion radical, phenyl radical, vinyl radical, cyclohexadienyl radical, cyclopropyl radical, cyclobutyl radical, cyclopentyl radical, pyridine, hydrogen cyanide, and formaldehyde. The main experimental observations used for the reflection of unpaired electron density in open shell systems were literature values of electron spin resonance nuclear hyperfine coupling constants. For closed shell systems, comparisons were made with charge distributions, calculated dipole moments, and orbital populations resulting from more advanced calculations, and with literature values of observed dipole moments. The various conclusions reached in the course of the investigation indicate that electron density distributions can be predicted in the above series of molecules without altering the semi-empirical parameters to fit the experimental results in each case. Dissert. Abstr.

N68-30895 Illinois Univ., Urbana.
FLASH PROTOLYSIS AND FLASH HEATING OF POTASSIUM PERMANGANATE CRYSTALS
Peter Shu-ti Lee (Ph.D. Thesis) 1967 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-11878

The reactions of solid potassium permanganate crystals exposed to high intensity photoflashes have been investigated. Crystals were flashed under various conditions of radiant energy, particle size, and temperature. The reaction products were MnO_2[sl. MnO_4, MnO_2, and unreacted MnO_4. As the flash energy was increased, the yield of MnO_2 decreased while those of MnO_2 and MnO_4 increased. This suggests that: (1) Two competitive reactions, the photochemical and photo sensitized thermal reactions, occur. (2) MnO_2 is photochemically produced, while MnO_2 and MnO_4 are associated with the subsequent thermal reaction. A simple picture of the reaction is proposed in terms of the photo sensitized thermal process. Dissert. Abstr.

N68-30906 Rice Univ., Houston, Tex.
RATES OF REARRANGEMENT OF ALLYLIC ESTERS IN A GAS PHASE STIRRED FLOW SYSTEM
James Theo Hill (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-13081

The rates of rearrangement of oxygen-18 and deuterium labelled allyl trifluoroacetate and of three isomeric trifluoromethylallyl trifluoroacetates have been measured in a gas phase stirred flow system. The labelling experiments indicate that each process involving a 1 3 migration of the carboxyl moiety is accompanied by the conversion of an alkoxy oxygen into a carbonyl oxygen. The slow rates at which the three isomeric trifluoromethylallyl trifluoroacetates are interconverted appear to be due to the inductive

effect of the CF_3 group. Using previously collected data for other allylic and carboxyl substituted esters in combination with these results leads to the postulation of a polar methanism. The extent of charge separation depends on the ability to stabilize incipient positive charge and negative charge. Dissert. Abstr.

N68-30924 Rice Univ., Houston, Tex.
CHEMICAL REACTIONS AT HIGH PRESSURES AND HIGH TEMPERATURES
Chin-hsiung Chan (Ph.D. Thesis) 1967 213 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-13058

Two high pressure devices, the opposed anvil and the tetrahedral anvil, have been used for studying chemical reactions at high pressures and high temperatures. The effect of pressure on the thermal decomposition of potassium chlorate and mercuric oxide has been determined experimentally. New cubic mercury and cadmium metaborates were isolated and studied. Group III superoxides have been synthesized under high pressures and their properties have been investigated by X-ray, infrared, electron spin resonance and chemical methods. Three new high pressure forms of $LiMO_2$ (M = B, Al and Ga) compounds have been synthesized and identified. It is found that γ-$LiBO_2$ and γ-$LiAlO_2$ could be synthesized directly by reacting lithium peroxide with boric oxide and aluminum oxide respectively. Dissert. Abstr.

N68-30946 University of the Pacific, Stockton, Calif.
A POLAROGRAPHIC STUDY OF SELECTED METAL COMPLEX IONS OF SEVERAL p-TOSYL AMINO ACIDS
Joseph Martin Reyes (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12100

A polarographic study of the complexes of selected metal ions and the p-Tosyl derivatives of the amino acids; glycine, glutamic acid and lysine has been made to determine their coordination number, formula, dissociation constant and free energy of formation. All polarographic measurements in this study were made using the Leeds and Northrup Electro-Chemograph Type E polarograph. Polarographic determinations were made in the conventional H-Cell immersed in a constant temperature held at 25°C. Dissert. Abstr.

N68-30951 Oklahoma Univ., Norman.
STUDIES OF LINE WIDTH OF MICROWAVE SPECTRA OF SYMMETRIC TOP MOLECULES
James Andrew Roberts (Ph.D. Thesis) 1967 129 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12005

This work discusses the instrumentation and development of a microwave spectrograph which is capable of producing line width determinations which are accurate to 2%. A detailed discussion of the Doppler contribution to line widths of spectral lines is given. The problem of multiple or overlapping spectral lines has been discussed and a general method of solution of the problem given. Specific problems arising in the NH_3 inversion spectrum due to quadrupole and magnetic hyperfine splitting has been discussed and solved with correction curves. Finally, a general attack has been made upon the line width parameters problem of symmetric top molecules. Dissert. Abstr.

N68-30954# Junta de Energia Nuclear, Madrid (Spain). Direccion de Quimica e Isotopos.
LEAD SHIELDED CELLS FOR THE SPECTROGRAPHIC ANALYSIS OF RADIOISOTOPE SOLUTIONS [DESCRIPCION DE UN EQUIPO, CON RECINTOS BLINDADOS, PARA EL ANALISIS ESPECTROGRAFICO DE RADIOISOTOPOS]
M. Roca, C. Capdevila, and F. de la Cruz Feb. 1967 20 p refs In SPANISH; ENGLISH summary
(JEN-188-DQ/I-64) CFSTI: HC $3.00/MF $0.65

Two lead shielded cells for the spectrochemical analysis of radioisotope samples are described: one of them is devoted to the evaporation of samples before excitation, and the other one contains a spectrographic excitation stand for the copper spark technique. A special device facilitates the displacement of the excitation cell on wheels and rails for its accurate and reproducible position as well as its replacement by a glove box for plutonium analysis. In order to guarantee safety the room in which the spectrograph and the source are set up is separated from the active laboratory by a wall with a window. Author (ESRO)

N68-30960# Junta de Energia Nuclear, Madrid (Spain). Division de Metalurgia.
CONTRIBUTION TO THE STUDY OF GASEOUS CARBURIZATION OF URANIUM [CONTRIBUCION AL ESTUDIO DE LA CARBURACION GASEOSA DEL URANIO]
J. Antonio Esteban, J. M. Jimenez, and P. de Villota Apr. 1968 28 p refs In SPANISH; ENGLISH summary
(JEN-177-DME/I-22) CFSTI: HC $3.00/MF $0.65

Thermal decomposition of uranium hydride powder obtained by hydrogenation of uranium turnings is studied along with carburization of the uranium hydride or metallic uranium powder with methane. A method of uranium monocarbide fabrication under static atmosphere is described. On this method hydrogen is removed by means of an uranium getter. Author (ESRO)

N68-30967 Columbia Univ., New York.
THE DETERMINATION OF THE FUGACITIES OF HYDROGEN IN HYDROGEN AND PROPANE MIXTURES USING A SEMI-PERMEABLE MEMBRANE
Herbert Wayne Cooper (Eng. Sc.D.) 1967 200 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-9331

Fugacities of hydrogen in the hydrogen–propane system have been determined at 100°, 160°, and 190°F at pressures up to 1500 psia. A semipermeable membrane technique utilizing a paladium–silver alloy as the membrane has been developed and shown to have several advantages over other methods of obtaining fugacity data. The experimentally determined fugacities were compared with values predicted from the following four frequently used equations of state of varying degrees of complexity: Redlich–Kwong equation, Black's equation, Benedict–Webb–Rubin equation, and the virial equation. The accuracy, required data, advantages and limitations of each are discussed. The activity coefficients of propane were determined from those of hydrogen by using the thermodynamically exact Gibbs–Duhem relationship. Dissert. Abstr.

N68-30984# Iowa State Univ. of Science and Technology, Ames
THE X-RAY CRYSTAL STRUCTURE DETERMINATION OF $Fe_3(CO)_{11}P(C_6H_5)_3$ AND THE DESIGN, INSTALLATION, AND AUTOMATION OF A NEUTRON DIFFRACTION SYSTEM
Donald James Dahm (Ph.D. Thesis) Feb. 1968 89 p refs
(Contract W-7405-ENG-82)
(IS-T-215) CFSTI: HC $3.00/MF $0.65

The crystal structure of $Fe_3(CO)_{11}P(C_6H_5)_3$ has been determined from three dimensional x-ray data. Sixteen molecules crystallize in the monoclinic space group $C_{2/c}$ with a = 37.14, b = 12.26, c = 26.05 A, and β = 93.96°. The structure was refined by full matrix least squares with iron and phosphorus atoms anisotropic to a conventional R value of 0.082 for 1800 reflections collected by counter methods. The structure is similar to that of $Fe_3(CO)_{12}$. The iron atoms form a nearly isosceles triangle with the short side connected by two asymmetric carbonyl bridges. The rest of the carbonyls are terminal. Each asymmetric unit contains two molecules which are structural isomers of one another, with the $P(C_6H_5)_3$ group attached to different iron atoms. On the basis of a qualitative molecular—orbital treatment, a lengthening of iron—iron bonds in $Fe_3(CO)_{11}P(C_6H_5)_3$ as compared to $Fe_3(CO)_{12}$

is rationalized as being due to increased population of antibonding orbitals. A Hilger–Watts four circle neutron diffractometer operates under the control of an SDS-910 computer. The interfacing and programming for the system are of local origin. A neutron beam forming an angle of 90° with the incident beam is taken from a beryllium monochromating crystal located inside the reactor face. Alignment of the diffractometer, both optically and with neutrons, the neutron detection devices, and other aspects of the system are discussed in some detail. Author (NSA)

N68-30991# National Inst. of Metallurgy, Johannesburg (South Africa). Analytical Div.
THE FLUORIMETRIC DETERMINATION OF URANIUM
T. W. Steele and R. V. D. Robert 19 Jul. 1967 10 p *Its* Lab. Method No. 92/47
(NIM-163)

Small amounts of uranyl nitrate were extracted into ethyl acetate in the presence of aluminum nitrate, which acts as a salting out agent. An aliquot portion of the organic layer is pipetted onto a pellet of sodium fluoride contained in a platinum dish, evaporated, and fused. The fluorescence of the fused cake is measured with a fluorimeter and compared with standard samples carried through the procedure with each fusion. The method is applicable to solutions and ores with a low uranium content. The lower limits of determination are 0.00003 g/l and 0.001% for solutions and ores, respectively. NSA

N68-30993# National Inst. for Metallurgy, Johannesburg (South Africa). Analytical Div.
THE DETERMINATION OF THIOCYANATE IN URANIUM SOLUTIONS
A. Danse, E. B. T. Cook, H. Stoch, and T. W. Steele 24 Apr. 1967 4 p *Its* Lab. Method No. 7/20
(NIM-167)

The procedure consists of passing the solution through a cation-exchange resin in the hydrogen form. The thiocyanate is determined in the eluate by the reaction with ferric chloride and spectrophotometric measurement of the red ferric thiocyanate complex. NSA

N68-30994# National Inst. for Metallurgy, Johannesburg (South Africa). Analytical Div.
THE DETERMINATION OF BERYLLIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
J. D. Taylor and T. W. Steele 15 May 1967 5 p *Its* Lab. Method No. 4/4
(NIM-173)

The sample is decomposed by a mixture of HCl, HF, H_2SO_4, and $HClO_4$. The beryllium is extracted with an accurately measured volume of n-butyl acetate from a solution at pH 6.4 that contains EDTA. The organic phase is aspirated into a nitrous oxide flame, the absorption measured, and the beryllium concentration is calculated by comparison with standard beryllium solutions treated in a similar manner. The method is applicable to the determination of more than 1 ppM in silicate and ore samples. NSA

N68-30998 California Univ., San Diego.
POLAR ADDITION OF HYDROGEN HALIDES TO ACETYLENES
Do-Jae Lee (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-12676

The reaction of 1 phenylpropyne with hydrogen chloride in acetic acid follows an apparent third order rate law, first order in the acetylene and second order in hydrogen chloride, and gives 1 chloro *cis* 1 phenylpropene (XI), 1 chloro *trans* 1 phenylpropene (XII), and propiophenone (XIV) as the major products. It was found that 1 acetoxy *cis* (XII) and 1 acetoxy *trans* 1 phenylpropene (XII) are also formed but are converted to propiophenone in a secondary reaction. In 1.0M acid the primary product distribution was shown to be: X, 70%; XI, 17%; XIV, 5%; XIII, 8%. The results indicate that vinyl carbonium chloride ion pairs are involved as intermediates. Addition of hydrogen chloride to 3 hexyne in acetic acid, on the other hand, yields predominantly 3 chloro *trans* 3 hexene (XXXV) and 3 hexanone (XXXVII) along with a trace amount of 3 chloro *cis* 3 hexene (XXXVI) at 25°. The ratio of XXXV to XXXVII is greatly affected by the acid concentration, by the presence of water and by the presence of tetramethylammonium chloride (TMAC). Dissert. Abstr.

N68-31007 California Univ., Berkeley.
STUDY OF METALLIC AND DIELECTRIC SPUTTERING BY NEUTRON ACTIVATION AND ELECTRON MICROPROBE ANALYSIS
Eric Hermon Hasseltine (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-11628

A neutron activation technique suitable for the determination of trace amounts of short lived radioisotopes has been developed and applied to the investigation of cesium ion sputtering of aluminum and aluminum oxide. The sputtering yields were measured as functions of cesium ion energy, crystal temperature, and the partial pressure of oxygen in the chamber. In all measurements the ion beam was normal to the target surfaces, which for aluminum were the (100) and (110) faces, and for aluminum oxide, the (001) face. For the dielectric, aluminum oxide, techniques for neutralizing the target surface and monitoring the ion beam current were devised. The sputtering yield increased monotonically for both substances in the 1 to 10 KeV ion energy range. A technique of scanning highly polished surfaces for trace impurities with an electron microprobe was developed to measure the angular distribution of sputtered aluminum atoms. Dissert. Abstr.

N68-31022# Mound Lab., Miamisburg, Ohio.
STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION, JULY–SEPTEMBER, 1967
12 Apr. 1968 71 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1430) CFSTI: HC $3.00/MF $0.65

Topics covered include: carbon isotope separation, separation of isotopes of stable gases, thermal diffusion research, and low-temperature research. NSA

N68-31086 Lehigh Univ., Bethlehem, Pa.
JOULE-THOMSON EFFECTS FOR TERNARY MIXTURES
Suman Trimbak Sabnis (Ph.D. Thesis) 1967 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-14951

A circulating system employing a throttling valve was used to measure integral Joule–Thomson effects in nitrogen, and two ternary mixtures consisting of helium, nitrogen, methane and hydrogen, nitrogen, methane respectively. Measurements on nitrogen and the two ternary mixtures were carried out at inlet pressures of 2420 psia and inlet temperatures from 199°K to 297°K. The observed outlet temperature-pressure pairs were fit to a polynomial expression with reduced pressure as the independent variable. Joule–Thomson coefficients were calculated from nitrogen and the two mixture polynomials from 0 to 2420 psia at intervals of 400 psia. These coefficients were compared with predicted Joule–Thomson coefficients from the virial equation and several empirical equations of state. Joule–Thomson coefficients of both mixtures were predicted to about 5 percent at temperatures above 228°K. Dissert. Abstr.

N68-31106# National Inst. for Metallurgy, Johannesburg (South Africa).
PRELIMINARY OBSERVATIONS ON THE AUTOMATION OF THE TBP METHOD FOR DETERMINING URANIUM

K. Lowe and P. K. Faure 12 Apr. 1967 19 p refs
(NIM-156; C.31/66; RR-156)

The results of a preliminary investigation of the possibility of using the Technicon AutoAnalyzer system for automating the analysis of uranium samples by the tri-n-butyl phosphate (TBP) method are given. Various problems on the chemical side dealing with the conversion of the manual method to an automated method are described, and possible solutions to these problems are outlined. On the physical side, details are given of the experience gained in getting the equipment to perform its designed function satisfactorily, with special reference to the requirements of the TBP method. Author (NSA)

N68-31107# National Inst. for Metallurgy, Johannesburg (South Africa).
THE SPECTROGRAPHIC DETERMINATION OF ZIRCONIUM IN URANIUM OXIDE
Gerda M. van Niekerk, A. E. Watson, B. T. Eddy, and T. W. Steele 20 Mar. 1967 5 p *Its* Lab. Method No. 40/5
(NIM-153)

The uranium oxide is mixed with 0.3% lanthanum oxide as an internal standard and 10% mixed carrier consisting of 5 parts of silver chloride to 1 part of sodium fluoride. Samples of the mixture are packed into a Scribner-type electrode and spectrograms are taken in an argon–oxygen atmosphere. NSA

N68-31109# National Inst. for Metallurgy, Johannesburg (South Africa).
DETERMINATION OF BERYLLIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
J. D. Taylor, P. K. Faure, and T. W. Steele 23 May 1967 18 p refs
(NIM-138; C.7/67; RR-138)

The development of a method for the determination of beryllium in silicate samples is described. The method employs extraction of beryllium, as cupferrate, into a fixed volume of butyl acetate from a solution with a pH value of 6.4 containing EDTA. The absorption is measured in an acetylene and nitrous oxide flame while the organic phase is being aspirated. When a sample weight of 1 g is used, the sensitivity of the methods is ~0.2 ppM Be in the solid sample. The coefficient of variation is 1.84% at a concentration of 0.03% BeO. Author (NSA)

N68-31110# National Inst. for Metallurgy, Johannesburg (South Africa).
THE POLAROGRAPHIC DETERMINATION OF TOTAL HEXAVALENT URANIUM AS URANYL FLUORIDE IN URANOUS FLUORIDE
J. J. Jacobs and P. K. Faure 2 Dec. 1966 20 p refs
(NIM-129; C.4/67; RR-129)

The dc and ac polarographic behavior of U(VI) in varying amounts of phosphoric and perchloric acids is described. The U(VI) wave was more sensitive in a mixture of these acids than in phosphoric acid alone. Fluoride and nitrate ions had no effect on the sensitivity when present in moderate amounts. The details of a method are given for determination of total hexavalent uranium as uranyl fluoride in uranous fluoride when a mixture of phosphoric and perchloric acids is used as the supporting electrolyte. Author (NSA)

N68-31125# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
HIGH PRESSURE CHEMISTRY AND STRUCTURE Final Report, 1 Feb. 1963 – 31 Jan. 1968
Ephraim Banks and B. Post Jan. 1968 97 p refs
(Contract DA-31-124-ARO(D)-70)
(AROD-3783-4-C; AD-670978)

Contents: High-pressure syntheses (Tungsten bronzes and related compounds, Semiconductor-metal transitions); The magnetic properties of some intermetallic compounds and their pressure dependence (Electronic structures, Indirect exchange interactions, Heisenberg exchange integral, Exchange interaction curves); Effect of pressure on the electrical conductivity of poly-acene radical polymers; Apparatus (Press, Piston-cylinder apparatus, Pressure cell, Girdle apparatus, Gasketing system, Sample cell assembly for a magnetic run, Calibration of the girdle, Isothermal D.T.A. measurements under high pressure, Noise thermometry at high pressures). TAB

N68-31143# ManLabs, Inc., Cambridge, Mass.
THERMODYNAMIC STUDY OF SYNTHESIS OF NEW COMPOUND PHASES UNDER HIGH PRESSURE Final Report, 1 Dec. 1965 – 30 Nov. 1967
Edward V. Clougherty and Larry Kaufman Feb. 1968 77 p refs
(Contract AF 19(628)-5745)
(AFCRL-68-0109; AD-670561)

A phenomological analysis and correlation of available volumetric and entropy data was performed for III-V compounds. The results of these procedures were used in the design of high pressure synthesis experiments to attempt to stabilize and retain the compound BSb. Thermodynamic data were calculated for certain III-V compounds for which such data have not been measured. The experimental results for the study of the B-Sb system at 30 and 50 kilobars suggest that a miscibility gap occurs in the liquid phase which prohibits the synthesis of BSb although pressure stabilization of the compound is predicted. An experimental survey of selected chemical stoichiometries which are Group IV element analogues and hence according to Hall and Compton candidate systems for new tetrahedral materials was conducted at 30 and 50 kilobars and elevated temperatures. No new materials were found at the selected stoichiometries but a new pressure stabilized phase, delta A2S3 was synthesized. An investigation of ternary systems containing the binary Group IV element analogue combination and a Group IV element showed that tetrahedral structures can be stabilized in this way. Attempts to stabilize the A2S3 stoichiometry with Ge to form Al2SGe were unsuccessful. A new high pressure stabilized phase with a NaCl cubic structure was produced in the Mo-C-N system. Author (TAB)

N68-31148# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATIONS OF THE MOESSBAUER EFFECT IN CHEMISTRY AND SOLID-STATE PHYSICS
28 Jul. 1967 28 p refs Transl. into ENGLISH from Intern. Atomic Energy Agency Tech. Rept. no. 50
(FTD-HT-23-664-67; AD-671129)

Analysis of the change in the charge radius of the Sn119 nucleus following excitation on the basis of the Moesbauer spectra: Use of Moesbauer spectroscopy to study barenes derived from stanno-organic compounds. TAB

N68-31153 Rensselaer Polytechnic Inst., Troy, N. Y.
THE CHEMISTRY OF SOME UNSATURATED AMIDES
Philip Charles Lang (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-12838

A practical synthesis of the potent muscarinic agent 1 [4 (1 pyrrolidinyl) 2 butynyl] 2 pyrrolidinone (oxotremorine) and several analogs were developed, starting from authentic 1 (2 propynyl) 2 pyrrolidinone, which underwent facile base-catalyzed rearrangement to 1 (1 2 propadienyl) 2 pyrrolidinone. This allene is further rearranged by secondary amines and base to 2 ethyl 1 pyrroline 3 carboxamides; the mechanism by which this rearrangement occurs is viewed as an isomerization and ring cleavage followed by an unusual intramolecular cyclization of a carbanion to an acetylenic bond. In contrast to the phenyl isocyanate adducts, acylation of 2 ethyl 1 pyrroline 3 carboxamides in aprotic solvents containing triethylamine gives exclusively 1 acyl 2 ethylidene 3 carboxamides which arise by migration of the double bond out of the pyrroline ring into an *exo*-position in the ethyl side chain. The relative stabilities of the exocyclic and endocyclic isomers is thought to depend on a combination of steric effect and on the electronegative

strength of the acyl group which influences the participation of an electron pair on nitrogen in resonance stabilized conjugation.
Dissert. Abstr.

N68-31162# Junta de Energia Nuclear, Madrid (Spain). Division de Quimica.
CONTRIBUTION TO THE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM BY CARRIER DISTILLATION METHOD [NUEVAS APORTACIONES A LA DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN MATERIALES DE URANIO POR EL METODO DE DESTILACION FRACCIONADA CON PORTADOR]
C. Capdevila Apr. 1967 24 p refs In SPANISH; ENGLISH summary
(JEN-191-DQ/I-65) CFSTI: HC $3.00/MF $0.65

The carrier distillation method for the determination of impurities in uranium was modified in order to obtain a greater sensitivity. Electrodes 9.5 mm. diam. with a crater 7 mm. diam. and 10 mm. deep were used, the weight of charge being 300 mg. The elements considered were: Al, As, B, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Si, Sn, Ti and V, over the range 0.01 to 30 ppm. Among the different carriers tested, AgCl and the mixtures (3:1) AgCl-AgF and (4:3) AgCl-Ga_2O_3 were chosen. The following experimental variables were studied: the concentration of carriers, the arc current, the size of the vent forming tool, and the volatilization rates of every element. Palladium, indium and silver were tested as internal standards. A standard deviation from ±9.5% to ±18.5% is reported.
Author (ESRO)

N68-31200# Weapons Research Establishment, Salisbury (Australia).
HIGH TEMPERATURE REACTIONS IN THE SYSTEM TANTALUM CARBIDE–TITANIUM NITRIDE–TUNGSTEN, TANTALUM CARBIDE–ZIRCONIUM NITRIDE–TUNGSTEN AND TANTALUM CARBIDE–HAFNIUM NITRIDE–TUNGSTEN
C. W. Le Maistre Mar. 1968 47 p refs
(WRE-CPD-141) CFSTI: HC $3.00/MF $0.65

The results of a study of the solid state reactions taking place at high temperatures between titanium nitride, zirconium nitride and hafnium nitride, separately, with tantalum carbide and tungsten are presented. Thermodynamic calculations indicated that none of the nitrides would react with tungsten, and only titanium nitride was likely to react with tantalum carbide. This was confirmed for a short duration (5 minutes) exposure by experiment. Some liquid phase was formed in the titanium nitride system at 2900°C due to carburization by the tantalum carbide, however as in the case of zirconium nitride melting of the nitride occurred at 2950°C. Hafnium nitride was found to remain solid at 3200°C, the melting point of the tungsten used.
Author

N68-31253# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie.
DISTRIBUTION OF METAL NITRATES IN THE SYSTEM PLUTONIUM TETRANITRATE, URANIUM OXYDINITRATE, AND NITRIC ACID/TBP-DODECANE [DIE VERTEILUNG DER METALLNITRATE IM SYSTEM $Pu(NO_3)_4$ + $UO_2(NO_3)_2$ + HNO_3/TEP-DODECAN]
G. Baumgaertel, W. Ochsenfeld, and H. Schmieder Dec. 1967 24 p refs In GERMAN
(KFK-680; EUR-3707.d)

Experimental distribution data were determined for the extraction system $Pu(NO_3)_4$–$UO_2(NO_3)_2$–HNO_3/TBP–dodecane in a wide uranium and plutonium concentration range. With the help of this data the distribution coefficients of U(VI) and Pu(IV) in TBP-dodecane could be determined with good accuracy. The equations developed were also used in stage calculations for extraction columns for reprocessing fast-breeder fuels.
Author (NSA)

N68-31268*# Illinois Univ., Urbana. Chemistry Dept.
PYROLYSIS AND PHOTOLYSIS OF 3 BENZYL AND 3 PHENYL 4 PHENYL 1,2,4 OXADIAZOLONE 5
J. H. Boyer and P. J. A. Frints [1968] 6 p refs
(Grant NGR-14-012-004)
(NASA-CR-95925) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The intermediacy of an azomethine nitrene generated from 3 benzyl 4 phenyl 1,2,4 oxadiazolone 5 by either pyrolysis or photolysis is doubly supported. A subsequent transformation into N, α diphenylacetamidine through intermolecular hydrogen abstraction is construed as a diagnostic test, and cyclization through insertion with a CH bond affords the best explanation for the formation of one of two possible five-membered rings. An indiscriminate nitrene would undergo cyclization to form both benzylbenzimidazole (1) and anilinoindole (2). Absence of indiscrimination is revealed in the formation of (1) but not (2) and is consistent with ring-closure from either an ionic or biradical form of the nitrene or from its tautomeric diazirine. It is of interest to note that azomethine nitrene apparently does not tautomerize into β anilino β styryl nitrene, C_6H_5CH = $C(NHC_6H_5)N$.
Author

N68-31271 Utah Univ., Salt Lake City.
SOME STUDIES IN X-RAY CRYSTALLOGRAPHY
William Denzil Jensen (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-11949

Computer indexing of X-ray powder patterns and the crystallography and structure of some highly-fluorinated compounds were studied. The Guinier–de Wolff focusing camera, which would probably permit indexing of many low-symmetry powder patterns, is illustrated with 4,4-dibromooctafluorobiphenyl and 1,10-phenanthroline monohydrate. The second study is concerned with some highly-fluorinated organic compounds. A structure determination is reported for decafluorobiphenyl, which crystallizes in an orthorhombic lattice. The space group is Fdd2 with eight molecules in the unit cell. The packing is predominately between carbon and fluorine. The two phenyl rings are mutually non-coplanar and there is evidence that the phenyl rings themselves are slightly nonplanar. The crystallography of undecafluorocyclohexane is reported in this study. Like dodecafluorocyclohexane, the molecules must either be rotating or have statistical randomness in the solid. The unit cell is face-centered cubic with a lattice parameter of 10.00 ± 0.02 A.
Dissert. Abstr.

N68-31272# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
PLUTONIUM-239 DETERMINATION BY RESIN PAPER ION-EXCHANGE SEPARATION AND LIQUID SCINTILLATION COUNTING
Carl Crisco and Henry F. Lada Dec. 1967 23 p refs
(NDL-TR-97; AD-665357)

The use of strongly basic anion-exchange resin paper provides a simple and relatively short assay method for direct isolation and subsequent liquid scintillation counting of 239Pu alpha particles. Various adsorption techniques, specificity, and cross-contamination were studied in the presence of the fission products 89Sr, 90Sr, 95Zr, 106Ru, 137Cs, and 144Ce. Resin paper separation of a pure 239Pu solution and a diverse ion solution, prepared from 239Pu contaminated soil, was compared with separation by (1) anion-exchange resin column, (2) thenoyl trifluoroacetone (TTA) liquid-liquid extraction, and (3) zirconium phosphate microcrystal column. The conclusions were that the type SB-2 strongly basic anion-exchange resin paper: Adsorbs 239Pu from a 7.5 N HNO3 solution; applies to solutions containing small amounts of fission products; compares favorably in reproducibility and recovery efficiency with thenoyl trifluoroacetone (TTA) solvent extraction and zirconium phosphate microcrystal column separation techniques; provides a simple and relatively quick procedure for analyzing large numbers of samples.
Author (TAB)

N68-31276 West Virginia Univ., Morgantown.
A DETERMINATION AND CORRELATION OF THE STABILITY CONSTANTS OF THE VARIOUS COPPER (2) COMPLEXES WITH THE ETHANOLAMINES, THE ISOPROPANOLAMINES, THE THREE HYDROXY-SUBSTITUTED AMINES OF 2-AMINO-2-METHYL-PROPANE, AND ETHANOLPROPANOLAMINE
Robert Brent Simmons (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-10852

The formulas and formation constants of the complex species formed in aqueous solution by the interaction of copper (II) with a series of alkanol-substituted monoamines and the hydroxide ion have been determined. The amines include the three ethanolamines, the corresponding isopropanolamines, the three hydroxy-substituted amines of 2-amino-2-methyl-propane, and ethanolpropanolamine. Standard and newly developed computational methods for the analysis of potentiometric, polarographic and spectrophotometric data have been applied to describe these systems continuously over the entire range of pH studied, approximately pH two to pH 12. At relatively low pH values nitrogen atom coordination or chelation with nitrogen atom and oxygen atom coordination predominates. As the pH is increased the tendency is to form complex species in which the proton of the chelated hydroxyl group is lost by reaction with hydroxide ion. The number of ligand molecules coordinated tends to decrease as the number of ligand hydroxyl groups increases. At the highest pH studied the complexes found have resulted from interaction of copper (II), alkanolamine, and hydroxide ions in the ratios 1:1:2, 1:2:2 and 1:1:3. For these complex species the log $B_{p,q}$ values are of the order of 17.5 to 21. Dissert. Abstr.

N68-31282*# Illinois Univ., Urbana. Chemistry Dept.
DEOXYGENATION OF ORGANIC NITRITES
J. H. Boyer and J. D. Woodyard [1967] 12 p refs
(Grant NGR-14-012-004)
(NASA-CR-95937) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Tri-*n*-butyl- and triphenylphosphine and triethylphosphite transform benzyl and *tert*-butyl nitrite into the corresponding alcohol. Pyrolysis of benzyl and *tert*-butyl hyponitrite in tri-*n*-butylphosphine also produces the expected alcohol, thereby supporting their formation in the deoxygenation of nitrites by tervalent phosphorus reagents. Author

N68-31285*# Scripta Technica, Inc., Washington, D. C.
THE VISCOSITY OF LIQUID NITROGEN, CARBON MONOXIDE, ARGON AND OXYGEN AS A FUNCTION OF TEMPERATURE [DIE VISKOSITAET VON FLUESSIGEM STICKSTOFF, KOHLEN-OXYD, ARGON UND SAUERSTOFF IN ABHAENGIGKEIT VON DER TEMPERATUR]
N. S. Rudenko and L. W. Schubnikow NASA Aug. 1968 5 p refs Transl. into ENGLISH from Physik. Z. Sowietunion (Kharkov), v. 6, 1934 p 470–477
(Contract NASw-1694)
(NASA-TT-F-11868) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The viscosity of liquid nitrogen, carbon monoxide, argon and oxygen as a function of temperature are measured in a temperature interval between the boiling point and the freezing point. Author

N68-31294# Rochester Univ., N. Y. Dept. of Chemical Engineering.
AN INTERPRETATION OF THE INFRARED SPECTRA OF FUSED SILICA
Gouq-Jen Su and Jan Bock May 1968 56 p
(Contract Nonr-668(19))
(TR-3; AD-671064)

A vibrational analysis was performed for fused silica assuming the existence of short range order in the glassy network. This short range order was described by an average structural unit based on the model of alpha-quartz. The analysis consisted of using a group theoretical method and the Wilson FG matrix techniques to predict sixteen normal mode vibrational frequencies based on a diagonal force field. The most probable value of the three force constants, which were obtained by making the best fit between the calculated vibrational frequencies and the measured spectral values, is: K sub r = 480,000 dynes/cm Si-O stretching; K sub alpha = 35,000 dynes/cm O-Si-O bending; K sub beta = 5,000 dynes/cm Si-O-Si bending. Although adherence to the selection rules was not observed, fifteen out of the sixteen predicted frequencies were within the experimental spectra of fused silica reported in the literature. Author (TAB)

N68-31297# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
STIMULATED EMISSION IN POLYATOMIC MOLECULES
W. Charles Carr and Richard W. Grow 27 Sep. 1967 209 p refs
(Grants NSF GR-843; NSF GK-29; NSF GK-1644)
(UTEC-MD-68-015; NSF-13; PB-178037) CFSTI: HC $3.00/MF $0.65

Comparison between the vapor pressure characteristics of pure elements and their associated molecular compounds is presented, with the observation that many molecular compounds of normally solid elements have significant vapor pressures at room temperatures. Because of this characteristic, it is postulated that the free atom or ion might be obtained in the gaseous state as a result of the dissociation of the molecular vapor, thus eliminating the need for heating the normally solid pure elements to high temperatures in order to obtain a gaseous media. The energy requirements for the dissociation and excitation of the polyatomic molecules SiCl4 and SnCl4 are known, and these values are given. It is pointed out that the excitation process can occur as a one-step or a two-step process. The observation of stimulated emission in SiCl4, SnCl4, SnBr4, and SnI4 is reported. Most of the lines are identified, and all those lines which are so identified are ion lines. Other characteristics of the lasing lines, such as enhancement of spontaneous lines, behavior as a function of current and pressure, etc. are also given. An over-all view of the dissociation and excitation process is presented which involves the aforementioned one-step process and other processes such as resonance transfer, cascade pumping, electron collision pumping, and resonance trapping. Author (USGRDR)

N68-31321 Pennsylvania Univ., Philadelphia.
ELECTRONIC SPECTRA OF PHENANTHRENE IN MIXED CRYSTALS
Gerald James Small (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-12806

The polarized absorption, fluorescence ($^1A_1 \rightleftharpoons {}^1A_1$) and phosphorescence ($^1A_1 \rightleftharpoons {}^3B_2$) spectra of phenanthrene-h_{10} and -d_{10} dissolved in a biphenyl lattice have been investigated at 4.2°K. The 3500 Å polarized absorption system of phenanthrene in fluorene has also been studied. Five b_2 antisymmetric fundamentals and one a_1 fundamental are identified as vibronic origins deriving their intensity from higher states of phenanthrene. Evidence is given to show that certain nontotally symmetric fundamentals of phenanthrene are particularly effective in deriving intensity from crystal states of the fluorene host. Polarized absorption measurements on the doublet components and other experimental evidence suggest that the doubling is due to the existence of two energetically inequivalent biphenyl sites which the phenanthrene molecule can occupy, the two sites related by an angular displacement of the phenanthrene molecule. Dissert. Abstr.

N68-31322 Pittsburgh Univ., Pa.
THE DISTRIBUTIONS OF SINGLE PARTICLE PARAMETERS: IMPLICATIONS FOR THE STRUCTURE OF LIQUID WATER

George Carl Stey (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-12595

General definitions are adopted for several types of single particle parameters which might characterize particle-environment interactions, specifically, single particle energies, volumes, and enthalpies, and some of the general properties of their statistical distributions are studied. Each moment of such singlet distributions is found to be separable into terms corresponding to the presence and absence of explicit correlations between the single particle variables. That set of moments containing contributions of the latter type exclusively is taken as defining a distribution of a "virtual single particle" (VSP) parameter, and uniquely determines, and is uniquely determined by, the dependence of the expectation value of the corresponding macroscopic variable on an intensive parameter characterizing its distribution. Dissert. Abstr.

N68-31323 Pennsylvania Univ., Philadelphia.
SYNTHESIS AND SPECTROSCOPIC STUDIES OF SELECTED SILICON HYDRIDES AND FLUORIDES
Taisuke Yoshioka (Ph.D. Thesis) 1967 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-12822

Reactions, structure, and bond properties of selected silicon hydrides and fluorides were studied. Disiloxane, $(SiH_3)_2O$, and methoxysilane, CH_3OSiH_3, underwent condensation reactions in the presence of base catalysts such as NH_3, LiH etc. at low temperatures in the presence of liquid phase. Silane, SiH_4, was eliminated and $(SiH_3O)_2SiH_2$ and $(SiH_3O)SiH_3$ were formed from $(SiH_3)_2O$, while $(CH_3O)_2SiH_2$, $(CH_3O)_3SiH$ and $(CH_3O)_4Si$ were produced from CH_3OSiH_3. The proton nuclear magnetic resonance spectra of $(SiH_3O)_2SiH_2$, $(SiH_3O)_3SiH$, $(CH_3O)_2SiH_2$, $(CH_3O)_3SiH$ and $(CH_3O)_4Si$ were examined. The coupling constant additivity concept, which holds reasonably well for substituted methanes, did not hold for $(SiH_3O)_2SiH_2$, $(SiH_3O)_3SiH$, $(CH_3O)_2SiH_2$ and $(CH_3O)_3SiH$. A new additivity relationship for calculating $J_{29_{Si-H}}$ values for the α protons of SiH_3SiH_2X compounds was derived. A synthetic method, using an appropriate silver salt, for converting an SiF_3-containing compound to a different SiF_3 compound was devised. The fluorine nuclear magnetic resonance spectra of SiF_3NCO and $SiF_3{}^{15}NCO$ were examined and fluorine chemical shift values, $J_{29_{Si-F}}$ coupling constants, and the first $J_{15_{N-F}}$ coupling constant in a silicon compound were obtained. Gas-phase infrared studies of SiF_3NCO and $SiF_3{}^{15}NCO$ were consistent with C_{3v} selection rules for these molecules. Argon and nitrogen matrices studies gave complex spectra which were not readily interpretable. Dissert. Abstr.

N68-31336# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.
REACTIONS OF IONIC HYDROGEN IN HYDROGEN AND IONIC DEUTERIUM IN DEUTERIUM; MOBILITIES OF HYDROGEN AND ALKALI IONS IN HYDROGEN AND DEUTERIUM GASES
T. M. Miller (Ga. Inst. of Tech.), J. T. Moseley (Ga. Inst. of Tech.), D. W. Martin (Ga. Inst. of Tech.), E. W. McDaniel (Ga. Inst. of Tech.) May 1968 43 p refs
(Contract N00014-67-A-0226; Proj. Squid)
(GIT-2-PU; AD-671065)

The results of a study of the transport and reaction properties of low-energy ions in hydrogen and deuterium gases are presented. The measurements included mobilities of D(+) and D3(+) ions in deuterium gas, the mobilities of the alkali ions Li(+), Na(+), and K(+) in H2 and D2 gases, and the reaction rate coefficients for the three-body ion-molecule reactions H(+) + H2 + H2 to H3(+) + H2; and D(+) + D2 + D2 to D3(+) + D2. In addition, a few data were gathered for the radial, or lateral, diffusion coefficient of H3(+) ions in H2 gas in order to attempt to resolve a large discrepancy between the published results of two other laboratories. TAB

N68-31347# IIT Research Inst., Chicago, Ill. Technology Center.
CHEMICAL REACTIONS IN MONOTHERMAL FIELDS Summary Report, 1 Dec. 1966–30 Nov. 1967
T. A. Erikson 29 Dec. 1967 15 p refs
(Contract F44620-67-C-0036)
(IITRI-C6099-1; AFOSR-68-1208; AD-670628)

The relationship of chemical-reaction and vapor-supply mechanisms to propellant sensitivity were studied. The explosive nature of vaporization is qualitatively recognized but not quantitatively appreciated. This is particularly evident with liquids in metastable states, such as superheated or negative pressure conditions. Shock-tube data are being used for the correlation and evaluation of practical performance in several specific propellants. The goal is to develop a capacity for predicting practical performance, outside its specific purpose, in sufficient detail allow an extension to sensitivity problems. Author (TAB)

N68-31349*# Illinois Univ., Urbana. Chemistry Dept.
ACID CATALYZED REACTIONS OF α AND β STYRYL AZIDES
J. H. Boyer, W. E. Krueger, and R. Modler [1967] 10 p refs
(Grant NGR-14-012-004)
(NASA-CR-95935) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Acid degradation of two vinyl azides, α and β-styryl azides, was investigated. In ethanolic sulfuric acid, the α-styryl azide was 94% transformed into a mixture of acetanilide and aniline. An unrearranged hybrid cation or other carbonium ion reactions were not detected. A previous study was considered inaccurate in which a resonance cation, with a vinyl nitrenium and a carbonium ion as contributors and in equilibrium with an azirinium cation, was proposed as an intermediate for the formation of benzaldehyde, formaldehyde, and a primary amine. In ethanolic sulfuric acid β-styryl azide is transformed into 7% phenylacetonile, a trace amount of 2 5-diphenylpyrazine, and intractable tar. The nitrile appears to result from either a rearrangement concerted with nitrogen evolution or from a hot nitrenium ion, whereas the pyrazine comes from the self-condensation of either phenacyclamine or α-amino-α-phenylacetaldehyde. Phenacyl amine may also be formed on combination of the carbonium ion with water. M.W.R.

N68-31365# Princeton Univ., N. J. Frick Chemical Lab.
VISCOSITY OF LOW MOLECULAR WEIGHT POLYMER SOLUTIONS OVER THE ENTIRE CONCENTRATION RANGE
Peter F. Lyons and Arthur V. Tobolsky May 1968 25 p refs
(Contract N00014-67-A-0151)
(ONR-TR-RLT-108; AD-670610)

An empirical equation is presented which describes the concentration dependence of the viscosity of low molecular weight (2000) poly (propylene oxide) solutions over the whole concentration range. The basis for the new equation is a consideration of the finite volume of the polymer molecules in solution. The new empirical equation fits the data extremely well over the whole concentration range for both a very good solvent (benzene) and a somewhat poorer solvent (methylcyclohexane). The hydrodynamic consequences of the thermodynamic interactions between polymer and solvent are reflected in the constants of the equation. A qualitative physical interpretation of this excluded volume equation is based on the limited interpenetration of the hydrodynamic polymer coils. Using the Debye or the Rouse-Bueche (DRB) formulation for the viscosity of a polymer solution, the proposed equation also describes the relative variation of the segmental (or bead) friction factor from infinitely dilute solution to bulk polymer. A Stokes law interpretation of the friction factor is shown to be reasonable at infinite dilution. Author (TAB)

N68-31437*# Illinois Univ., Urbana. Chemistry Dept.
NITROSOAZOMETHINE DERIVATIVES
J. H. Boyer and P. J. A. Frints [1967] 11 p refs
(Grant NGR-14-012-004)
(NASA-CR-95936) CFSTI: $3.00 CSCL 07C

To investigate deoxygenation of nitrosoazomethine derivatives (3) as a method for generating azomethine nitrenes (4), oxidation and dehydrogenation of secondary amidoximes were used as techniques for preparing these nitroso compounds. Experimental data are presented on the oxidation of the oxime (1) of benzanilide with solutions of lead tetraacetate, of N-bromosuccinimide, and of diethyl azodicarboxylate; the oxidation of N-phenylhydroxylamine by diethyl azodicarboxylate; and the reactions of benzonitrile oxide and the oxime (1) of benzanilide. M.G.J.

N68-31441# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EFFECT OF SINTERED URANIUM DIOXIDE POROSITY IN THE KINETICS OF GRAIN GROWTH [EFFETTO DELLA POROSITA DELL'UO_2 SINTERIZZATO SULLA CINETICA DI INGROSSAMENTO DEI GRANI]
C. Lepscky, B. Marsico, and G. Pugnetti 1968 43 p refs in ITALIAN
CFSTI: HC $3.00/MF $0.65

Two series of sintered UO_2 samples, respectively 87% and (95% of the theoretical density (10.97 gr/cm^3) were isothermally annealed at 2080°C in an induction oven of high frequency, for times varying from 30 minutes to 6 hours. The analysis of the grains revealed the following: (1) development of a method for grain growth of high density UO_2 that conforms with the theoretical equations, (2) identification of the experimental parameters necessary for the quantitative application of the theoretical equations of grain growth to irradiated samples, (3) development of a method for stopping the grain growth in low density UO_2 and a tentative quantitative interpretation based on the results by Zener, and (4) the formation of basaltic grains in samples of low density UO_2. Transl. by F.O.S.

N68-31469*# Ohio State Univ., Columbus. ElectroScience Lab.
VIBRATION-ROTATION BANDS OF ASH_3 IN THE 2μ REGION
P. K. L. Yin 25 Jul. 1968 22 p refs
(Grant NSG-74)
(NASA-CR-95985; REPT.-1093-41) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The vibration-rotation bands of AsH_3 in the 2$_\mu$ region were analyzed. The resonance effect, especially the ν_1 and the ν_3 bands for the K-type doubling and the Giant l-type doubling in the 4μ regions, are described briefly. Some new combination difference relations in obtaining ground state constants from a perpendicular band are presented. Author

N68-31485# Joint Publications Research Service, Washington, D.C.
PROTECTIVE ACTION OF ORGANOPHOSPHOROUS COMPLEXING AGENTS IN POISONING BY SOLUBLE BERYLLIUM COMPOUNDS
O. G. Arkhipova and P. P. Dvizhkov 25 Jul. 1968 8 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), May 1968 p 26–31
(JPRS-45973)

Despite the many studies on pathogenic therapy of beryllioses, the problem is still unresolved. O. G. Arkhipova and co-authors reported that aminoalkylpolyphosphinic acids form a stable soluble nonionized complex with beryllium and accelerate the excretion of beryllium from the body. Of low toxicity, these acids in the usual doses do not cause any changes in experimental animals and they are quickly excreted. The extent to which aminoalkylphosphinic acids affect the outcome of beryllium chloride and sulfate poisoning and the morphological changes brought about by introducing beryllium into animals was studied. The work was done on white mice weighing 20±2 g and white rats weighing 170±15 g. Author

N68-31491# Technische Hogeschool, Eindhoven (Netherlands).
THE COBALT OXIDE-MOLYBDENUM OXIDE-ALUMINUM OXIDE CATALYST
Johannes Maria Jacobus Gerardus Lipsch (Ph.D. Thesis) 4 Jun. 1968 109 p refs
CFSTI: HC $3.00/MF $0.65

Identification was made of the cobalt molybdates, and the structure of the CoO-MoO_3-Al_2O_3 catalyst used in the oil industry was studied. Possibilities of compound formation between cobalt or molybdenum with the aluminum oxide carrier were considered, including the distribution of the compounds over the carrier. Catalyst activation and catalyst reduction were studied, with particular attention to the hydrosulfurization of thiophene and to reactant adsorption. A reaction mechanism was constructed based on the catalyst structure to explain the reaction kinetics. Influence of temperature and addition of water and pyridine on the catalytic reaction are also considered. M.W.R.

N68-31524*# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.
THE INTERACTION OF OXYGEN ATOMS WITH SOLID SURFACES AT EV ENERGIES Annual Status Report No. 1, 1 Jun. 1967–31 May 1968
G. D. Magnuson, J. W. Boring, and R. R. Humphris Jun. 1968 11 p refs
(Grant NGR-47-005-077)
(NASA-CR-96136; EP-40II-102-68U) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Reported is the design and construction of a stainless steel atomic oxygen beam system that produces oxygen atoms having a kinetic energy of 4–10 eV. The beam system consists of an ion source, mass analysis chamber, neutralization chamber, and an ultra-high vacuum target chamber. A CO_2 ion source generates negative oxygen ion beams at a filament lifetime of about 50 hour. G. G.

N68-31561# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
HIGH TEMPERATURE rH-pH DIAGRAMS FOR THE SYSTEM URANIUM (VI) NITRATE-WATER
B. W. Edenborough (New South Wales Univ.), and R. G. Robins (New South Wales Univ.) Apr. 1968 20 p refs Submitted for publication
(AAEC/TM-447)

A method for calculating thermodynamic equilibrium relations in the system U(VI) nitrate–water up to 300°C is presented, and rH–pH diagrams constructed for temperatures of 25, 60, 100, 150, 200, and 300°C (rH = logarithm of the partial pressure of hydrogen gas). The method involves the use of the correspondence principle and takes into account activity–concentration relations and the effect of added nitric acid. Author (NSA)

N68-31569# California Univ., Livermore. Lawrence Radiation Lab.
INVESTIGATION OF THE AQUEOUS SOLUTIONS OF THORIUM PERCHLORATE [ISSLEDOVANIYE VODNYKH RASTVOROV PERKHLORATA TORIYA]
V. I. Rigin Apr. 1968 10 p refs Transl. into ENGLISH from Tr. Sib. Tekhnol. Inst. (USSR), no. 36, 1963 p 79–81
(UCRL-TRANS-10238) CFSTI: HC $3.00/MF $0.65

Thorium perchlorates were prepared and their behavior in aqueous solutions was studied. The hydrolysis of thorium was studied in a perchlorate medium at an ionic strength μ = 3, and the type of predominant ion was established. NSA

N68-31579# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
AQUEOUS REPROCESSING IN A MULTIPURPOSE PLANT

T. J. Barendregt, E. Detilleux, and R. Rometsch Nov. 1967 38 p Presented at the symp. on Recent Advan. in Reprocessing of Irradiated Fuels, New York, 30 Nov. 1967
(NP-17368; ETR-210; CONF-671103-5)

A brief outline of the reasons for establishing Eurochemic and the aims of the Company are given. This is followed by a description of the plant design and layout and the choice of process, chemical rather than mechanical. The methods used for accurate accountability of fissile material and for maintaining the required nuclear safety level are dealt with and the experience gained during the first year of operation is summarized. Author (NSA)

N68-31582# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
HEAVY WATER REACTOR CHEMISTRY STUDIES. PART 2: THE ANALYSIS OF EXHAUSTED HIFAR ION-EXCHANGE RESINS
Helen F. Ryan and L. E. Smythe Jan. 1968 18 p refs
(AAEC/TM-428)

Four batches of exhausted HIFAR ion-exchange resins were analyzed to obtain information on the nature of impurities in the system and on corrosion and radiation degradation of the resins. The life of the ion exchanger was found to be governed by the carbon dioxide in the circuit, the major source of which was the radiation degradation of the resins. Methods for prolonging the life of the HIFAR ion exchanger were considered. Author (NSA)

N68-31643# Tennessee Valley Authority, Oak Ridge.
ABSORPTION OF SULFUR DIOXIDE BY AMMONIUM SULFITE-BISULFITE SOLUTION IN A SPRAY-TYPE VENTURI SCRUBBER
B. P. Volgin, T. F. Efimova, and M. S. Gofman 15 Sep. 1967 13 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), v. 43, no. 2, 1967 p 132–136
(TVA-P-4260; PB-178102T) CFSTI: HC $3.00/MF $0.65

Experimental data are presented which indicate that multistage absorption in Venturi scrubbers makes them competitive with packed column and bubble absorbers in resistance and electric energy consumption. Capital expenditures for equipping are lowered by a factor of 2.5 to 3.0 and expenditures for the building (the overall dimensions of the Venturi scrubbers are relatively small) are 1.5 to 2 times lower. USGRDR

N68-31646# Du Pont de Nemours (E. I.) and Co., Buffalo, N. Y. Film Dept.
TRIPTYCENE POLYMERS
E. Hoffmeister, J. E. Kropp, R. H. Michel, and W. L. Rippie [1967] 22 p refs
(PUBL.-233)

Bifunctional, bridgehead substituted triptycene derivatives were used to prepare a series of new polymers, including polyesters, polyamides, polyurethanes, a polyoxadiazole and a polyanhydride. Certain of these partially aliphatic polymers were thermally stable. Clear and colorless films were obtained from a number of these polymers. Author

N68-31647# Du Pont De Nemours (E. I.) and Co., Buffalo, N. Y. Film Dept.
BIFUNCTIONAL TRIPTYCENE DERIVATIVES
E. Hoffmeister, J. E. Kropp, T. L. McDowell, R. H. Michel, and W. L. Rippie 20 Jun. 1967 15 p refs
(Publ.-232)

The reaction of benzyne with two 9 10-disubstituted anthracenes—9 10-bis (acetoxymethyl) anthracene and 9 10-anthracenediacetic acid diethyl ester – yielded new bridgehead disubstituted triptycenes. These were converted to a series of bifunctional triptycene derivatives through simple chemical transformations. Author

N68-31662# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
THE DETERMINATION OF HYDROGEN IN IRRADIATED ZIRCONIUM ALLOYS
M. E. Lambert and J. A. J. Walker 22 Mar. 1968 11 p refs
(TRG-1669(C)) CFSTI: HC $3.00/MF $0.65

A method is described for the determination of hydrogen in zirconium alloys by heating the sample to 1200°C and removing the liberated hydrogen in a stream of helium. The hydrogen is converted to water which is measured by an electrolytic hygrometer. A sample holder and furnace system which has been fully automated for routine analysis is also described. The coefficient of variation is not greater than 6% for samples weighing 0.1 – 0.25 g with hydrogen contents of 30-2000 ppm. Author

N68-31676# Tennessee Valley Authority, Oak Ridge.
PHOTOELECTROCHEMICAL STUDY OF ANODIC DISSOLUTION OF IRON
A. Sh. Valeev and M. A. Chvala 1 Sep. 1967 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 11, 1965 p 1946–1949
(TVA-P-4254; PB-178100T) CFSTI: HC $3.00/MF $0.65

A distinct connection between the rate of decay of the photoeffect and surface structural changes was established by the photoelectrochemical studies of anodic dissolution of iron: submicroscopic surface smoothing takes place during the onset of the very slowly decaying photoeffect. A hypothesis is drawn on the interdependence of submicroscopic surface smoothing and the surface formation of an oxide film of relaxing electron composition. Author (USGRDR)

N68-31678# Rochester Univ., N. Y. Dept. of Chemical Engineering.
INFRARED SPECTRA OF VITREOUS GERMANIUM DIOXIDE
Gouq-Jen Su and Benjamin Teh-Kung Chen 15 May 1968 50 p refs Supported in part by ARPA
(Contract Nonr-668(19))
(TR-2; AD-671194)

The infrared absorption and reflection spectra of vitreous germanium dioxide were measured in the frequency region 4,000 to 80/cm. A short range order that can characterize the vitreous GeO2 network is derived from the x-ray work of Nelson, Siegel and Wagner and Smith and Isaacs. A vibrational analysis involving the calculation of the vibrational frequencies of the normal modes of the average structural unit was carried out using the Wilson FG-Matrix technique and a group theoretical method. Three force constants were obtained and the sixteen corresponding frequencies so calculated are compared with the measured spectra. The calculated frequencies and the force constants used are presented in the following table. In spite of the approximate nature of the structural unit and calculations, the agreement between the observed and calculated frequencies is very good. Force constants, in dynes/cm are: Ge-O bond stretching force constant k sub r = 395,000; O-Ge-O angle bending force constant k sub alpha = 17,000; Ge-O-Ge angle bending force constant k sub beta = 2,400. Author (TAB)

N68-31702# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR THE FIRST HALF OF 1967 COMPILED BY A COMPUTER METHOD
J. Capellen, H. J. Svec, J. R. Jordan, and W. J. Watkins Apr. 1968 350 p refs
(Contract W-7405-ENG-82)
(IS-1829) CFSTI: HC $3.00/MF $0.65

The 3569 references given cover the first half of 1967. The report consists of three sections: a bibliography section, and author index section, and a key word out of context index (KWOC

index) section. The bibliography section lists the authors, the title, and the source citation for each article. The author index lists the authors' names and the reference numbers of their articles. The KWOC index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of their titles. Author (NSA)

N68-31704# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
TABLES OF MASS ABSORPTION COEFFICIENTS FOR USE IN X-RAY SPECTROCHEMICAL ANALYSIS
K. P. Champion, H. J. Hurst, and R. N. Whittem Apr. 1968 98 p refs
(AAEC/TM-454)

Leroux's data were used to construct a table of mass absorption coefficients (μ/ρ) for each element at a selection of wavelengths. Three sets of tables are presented, depending on the choice of wavelength intervals: arranged by K_α wavelengths, arranged by L_α wavelengths, and arranged by incremental wavelengths. NSA

N68-31708# National Aeronautics and Space Administration, Washington, D. C.
CYANOACETYLENE. PART 1: SYNTHESIS AND SOME CHEMICAL PROPERTIES
Shunsuke Murahashi, Takeo Takizawa, Shohei Kurioka, and Shoji Maekawa Jun. 1968 7 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi, J. of the Chem. Soc. of Japan, Pure Chem. Sect. (Tokyo), v. 77, 1956 p 1689–1692
(NASA-TT-F-11771) CFSTI: HC $3.00/MF $0.65 CSCL 07C

An improved method for synthesis of cyanoacetylene is described. The basic method goes stepwise from the conversion of acetylene to propiolic acid, to the amide, and then dehydration to yield the nitrile. Forming the amide in liquid ammonia at low temperature, and suspending P_2O_5 in dry xylol for dehydration considerably improved the overall yield. Some of the chemical properties of cyanoacetylene are shown, and several chemical reactions are described. D.H.B.

N68-31747# Los Alamos Scientific Lab., N. Mex.
MASS TRANSFER OF OXYGEN IN SODIUM COLD TRAPS
Charles C. Mc Pheeters 27 May 1968 64 p refs
(Contract W-7405-ENG-36)
(LA-3936) CFSTI: HC $3.00/MF $0.65

Low temperature precipitation of CO is a method of removing O_2 from solution in liquid Na commonly called cold trapping. NaO precipitation is assumed to be a heterogeneous process because of the strong effect of surface area on the rate of precipitation. Growth of crystals from a super-saturated solution is said to proceed according to the equation $dm/dt = kA(C-C_s)$ where dm/dt is the rate of O_2 accumulation on the crystal, k is an overall mass transfer coefficient including a diffusion step and a surface deposition step, A is the crystal surface area, C is the O_2 concentration in the bulk stream, and C_s is the equilibrium O_2 concentration at the temperature of the crystal. Mass transfer coefficients were calculated by measuring the rates of O_2 concentration changes during cold trapping runs and by correlating these rates with the surface area available for precipitation. The mass transfer coefficient was found to be a function of both Reynolds number and temperature. Author (NSA)

N68-31749# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DETERMINATION OF MICROGRAM QUANTITIES OF FLUORIDE IN METALOXIDES
C. E. Plucinski [1968] 6 p Presented at the Am. Chem. Soc. Meeting, Portland, Oreg.
(Contract AT(45-1)-1830)
(BNWL-SA-1790; CONF-680808-2) CFSTI: HC $3.00/MF $0.65

Use of a fluoride-sensitive electrode for fluoride measurements in oxides is discussed. The calculated relative standard deviation of 16 results from measurements on U_3O_8 is 3%. NSA

N68-31775# Air Force Office of Scientific Research, Washington, D. C.
A PRELIMINARY EVALUATION OF THE APPLICATION OF ATOMIC FLUORESCENCE SPECTROSCOPY TO SPECTROMETRIC OIL ANALYSIS—A COUPLING STUDY OF GRANT NO. IAF-AFOSR-1033-66
William O. Davis 19 Apr. 1968 15 p refs
(AFOSR-68-0761; AD-670568)

The report investigates the feasibility of using atomic fluorescence spectroscopy as the instrumental technique in the spectrometric oil analysis program (SOAP). The technique is compared with the other available methods of atomic emission and atomic absorption spectroscopy. It is concluded that atomic fluorescence spectroscopy has advantages over the other methods and additional effort should be spent on its development. Author (TAB)

N68-31784# National Research Council of Canada, Ottawa (Ontario).
REACTIVITY OF NON-STOICHIOMETRIC BLACK ALUMINA [REACTIVITE DES ALUMINES NOIRES NON STOECHIOMETRIQUES]
B. Arghiropoulos 1968 21 p refs Transl. into ENGLISH from Proc. Intern. Symp. Reactivity Solids, 4th, Amsterdam, 1960 p 525–539
(NRC-TT-1325) CFSTI: HC $3.00/MF $0.65

When a refractory oxide, like alumina, is: (1) in divided state (porous) and, (2) poorly crystallized or amporphous, a stoichiometric defect of oxygen is produced on the surface of the solid by heating at 500° in a vacuum. The non-stoichiometric alumina is black, remains amorphous, and exhibits n-type semiconductivity. Heating at 500° in oxygen brings back the white colour and produces an increase of electrical resistance as well as a better crystalline organisation. At 1000°, the influence of the atmosphere (oxygen or vacuum) on the crystalline evolution is also observed. These ions can be strained, however, and then probably displaced from their equilibrium positions. This is done by compression of the second type powdered alumina in a die at 500° pressures from 1 to 5 tons/cm^2. After heating in vacuo at 500°, the compressed alumina exhibits stoichiometric defect of oxygen, black colour, n-type semiconductivity, and a regression of crystalline structure toward a more disorganised arrangement. Author

N68-31786# National Research Council of Canada, Ottawa (Ontario).
VIBRATIONAL SPECTRA OF ETHYL ALCOHOL AND ITS DEUTERIUM ANALOGUE CH_3-CH_2OD
C. Tanaka 1968 18 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Japan), v. 83, no. 7, 1962 p 792–798
(NRC-TT-1307) CFSTI: HC $3.00/MF $0.65

The author determined the infrared absorption spectra of C_2H_5OH and C_2H_5OD as a gas, liquid and solution, and also determined the Raman spectrum as a liquid and measured its polarization. Based on these results, the author made an assignment of the vibrational spectrum in the 1500 – 400 cm^{-1} region. The results satisfied the relationship required by the product rule. Further, the author presented the results of the determination of the inplane deformation and skeletal stretching vibration of the hydroxyl groups of methyl alcohol, ethyl alcohol, isopropyl alcohol and tert-butyl alcohol and their deuterium substitutes, in tables. Author

N68-31798# Queensland Univ., Brisbane (Australia).
CHARGE AND ENERGY TRANSFER IN ORGANIC SYSTEMS Final Report, 1 Mar. 1965–1 Sep. 1967
Lawrence E. Lyons 22 May 1968 38 p refs
(Grant AF-AFOSR-863-65)
(AFOSR-68-1344; AD-670580)

The electrical and photoelectrical properties of molecular crystals are described in terms of the intrinsic energy gap, EG EG is evaluated from the ionization energies of molecules, the electron affinities of molecules and the polarization energies of charges in the crystals. Each of these parameters was determined for a number of crystals. High pressure effects on electrical conduction were explained as a result. The temperature dependence of steady state currents through anthracene crystals was found to obey the compensation effect which is partly explained. Exciton-excitons interactions have been shown able to explain new results on transient currents through anthracene. Motion of charges in anthracene has been established by ESR for samples doped with alkali metals. Defects in phenanthrene crystals were observed in fluorescence. Author (TAB)

N68-31803# National Research Council of Canada, Ottawa (Ontario).

PERIODIC EXCITATION AND MEASUREMENT OF FAST CHEMICAL REACTIONS [PERIODISCHE ANREGUNG UND MESSUNG SCHNELLER CHEMISCHER REAKTIONEN]

H. Rueppel, V. Buettemann, and H. T. Witt 1968 20 p refs Transl. into ENGLISH from Ber. der Bunsenges. Physik. Chem. (Germany), v. 68, no. 4, 1964 p 340/348
(NRC-TT-1324) CFSTI: HC$3.00/MF$0.65

Relaxation methods have been developed for the study of fast chemical reactions. With these methods chemical equilibrium is disturbed by a rapid change of temperature, pressure, intensity of light or radiation etc. The following equilibration process is observed by changes of absorption, fluorescence, conductivity etc. The feasibility of relaxation measurements depends on the signal-to-noise ratio s/n of the signal by which the course of reaction is recorded. The large bandwidth which is necessary to record fast reaction signals causes a high noise level, i.e. a poor s/n-ratio. This disadvantage may be avoided if the perturbation is periodically performed by a rapid change of temperature, pressure, intensity of light or radiation. Thus, the high contents of information contained in periodic signals may be evaluated to increase s/n-ratio. Author

N68-31804# National Research Council of Canada, Ottawa (Ontario).

NEGATIVE IONS FROM ALKALI HALIDES AND ELECTRON AFFINITIES OF ALKALI METALS AND ALKALI HALIDES [NEGATIVE IONEN AUS ALKALIHALOGENIDEN UND ELEKTRONENAFFINITATEN DER ALKALIMETALLE UND ALKALIHALOGENIDE]

H. Ebinghaus 1968 11 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 19A, 1964 p 727–732
(NRC-TT-1316) CFSTI: HC$3.00/MF$0.65

The formation of negative ions from alkali halide vapours by electron resonance capture was investigated by mass spectrometry. The ions found, of the form M^-, X^-, MX^-, and M_2X^-, (M = Li, Na, K, Rb, Cs; X = F, Cl, Br, I) could be said, on the basis of the energetics and relative intensities, to originate from monomeric and dimeric molecules. From the measured appearance potentials and known dissociation energies, lower limits were established for the electron affinities of the alkai metals. These are in the vicinity of 0.5 ev. For some alkali halides, they are about 1.2 ev. In the case of the alkali metals, presumably these values are the actual electron affinities. Following the reports from various quarters on the formation of positive ions from alkali halides by electron impact, it appeared interesting also to investigate the formation of negative ions from alkali halide molecules, especially as there was a possibility of determining the electron affinities of the alkali metals, for which there had hitherto been scarcely any experimental data, although many theoretical values were available. The measurements were restricted to resonance captures, i.e. to electron energies of less than 10 ev. Author

N68-31805# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

THE FREQUENCIES AND INTENSITIES OF CARBON DIOXIDE ABSORPTION LINES BETWEEN 12 AND 18 MICRONS

S. R. Drayson and C. Young Nov. 1967 59 p refs
(Contract CWB-11376)
(TR-08183-1-T; PB-178067) CFSTI: HC$3.00/MF$0.65

A listing of frequencies and intensities of molecular absorption lines of CO2 in the spectral region 12 to 18 microns is presented. The intensities are given at six temperatures (300, 275, 250, 225, 200 and 175K) and include five isotopic molecules (12C 16O 16O, 13C 16O 16O, 12C 16O 18O, 12C 16O 17O and 13C 16O 18O). Author (USGRDR)

N68-31847# National Research Council of Canada, Ottawa (Ontario).

THE CHARACTERISTICS OF THE THERMAL ETHYLENE-BROMINE ADDITION REACTION AT LOW TEMPERATURE [AZ ETILEN ES BROM KOZOTT ALACSONY HOMERSEKLETEN LEJATSZODO TERMIKUS ADDICIOS REAKCIO JELLEGEROL]

T. Berces 1967 13 p Transl. into ENGLISH from Magy. Kem. Folyoirat (Hungary), v. 70, 1964 p 138–142
(NRC-TT-1300) CFSTI: HC$3.00/MF$0.65

The thermal reaction between ethylene and bromine has been studied at 10–20°C. In disagreement with previous investigations it may be shown that some experimental findings cannot be explained on the basis of a heterogeneous bimolecular mechanism. According to these experimental facts (induction period, influencing effect due to impurities and oxygen, abnormal reaction order and temperature coefficient, wall and end-product catalysis, etc.), the reaction should be regarded as a chain process. Author

N68-31851# Aeronautical Research Labs., Melbourne (Australia).

THE EFFECT OF SOLUTION COMPOSITION ON ANODIC PROCESSES AND CORROSION OF IRON

K. F. Lorking Mar. 1967 9 p refs
(ARL/MET-49) CFSTI: HC$3.00/MF$0.65

A potentiostat has been used to study the electrochemistry of iron over a wide range of pH in decinormal solutions of the sodium salts of five different anions. Measurements were also made of the weight losses due to corrosion. Results have shown that each anion has a specific effect on the corrosion rate through its influence on ferrous ion formation and on passivation of the iron surface. Author

N68-31868# General Electric Co., Philadelphia, Pa. Missile and Space Div.

SPECTROSCOPIC STUDIES OF THE VAPORIZATION OF HIGH TEMPERATURE MATERIALS Final Report, Jan. 1965–Dec. 1966

Milton J. Linevsky Apr. 1968 45 p refs
(Contract AF 49(638)-1513)
(AFOSR-68-1211; AD-670626)

The techniques of matrix isolation were used to obtain the infrared spectra of several high temperature molecules. An injector Knudsen cell was added to the general methods of matrix isolation resulting in further versatility of the method. Spectra of species produced by the reaction of a condensed phase and gas phase can now be studied. The following molecules were studied: HBO2, BOCl, BOF, FeF2, CrF2, CrF3, CrCl2 and LiOH. In most cases tentative frequency assignments were made and structural properties inferred. Atomic resonance line absorption studies were carried out on AlN. The heat of formation at 298K was found to be -718 plus or minus 2 kcal/mole based on the observed vapor pressures. Author (TAB)

N68-31879# Michigan Univ., Ann Arbor.
GAS CHROMATOGRAPHIC SEPARATION OF LOW MOLECULAR WEIGHT FLUOROCARBONS
Robert N. Bright and Richard A. Matula Mar. 1968 16 p refs
(Grant AF-AFOSR-1144-67)
(Publ.-68-3; AD-670834)

Application of gas-solid chromatography techniques to the separation of low molecular weight fluorocarbons incorporates a number of advantages over previous analysis techniques. These advantages include isothermal operation up to 200C, elimination of substrate bleed, stability of the base line, minimum retention times and convenience. The relative retention volumes with respect to perfluoroethane of a number of low molecular weight fluorocarbons as a function of column support material and operating conditions are reported. The separation of a number of important species which are formed during the thermal oxidation of low molecular weight fluorocarbons are also discussed. Author (TAB)

N68-31880# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
NON-ISOTHERMAL STUDIES OF CHEMICAL AND PHYSICAL REACTIONS. PART 1: KNUDSEN CELL VAPORIZATION OF SILVER AND BORON NITRIDE
Technical Report, 1 Oct. 1965–15 Oct. 1967
Emile Rutner and Gerard L. Haury Apr. 1968 45 p refs
(AFML-TR-67-392, Pt. 1; AD-670827)

A technique was devised for studying non-isothermal changes in properties or compositions. The required data in this technique are the total change in property or composition, the temperature-time behavior, and either some assumptions about the temperature behavior of the system or the expression for the rate of change of a property or the composition. The technique was tested by applying it to two different evaporating systems whose products of evaporation effused through a Knudsen cell orifice. For example, the vapor pressures, P, of silver and boron nitride were determined as a function of temperature, T, both isothermally and non-isothermally. The technique is especially applicable in studying decomposing systems in a mass spectrometer, where the relative concentration of the species being evaporated as a function of time and temperature can be followed. The treatment of data can be adapted to the direct calculation of mass loss, changes in properties of systems, and/or changes in composition of various systems, such as ablating systems. TAB

N68-31884# Oak Ridge National Lab., Tenn. Isotope Information Center.
PHOTONEUTRON METHOD OF ISOTOPIC ANALYSIS OF HYDROGEN IN NATURAL WATERS
V. K. Khristianov and V. I. Vernadskii [1968] 6 p refs Transl. into ENGLISH from Isotopenpraxis (USSR), v. 3, 1967 p 235–237
(ORNL-TR-1925) CFSTI: HC $3.00/MF $0.65

A photoneutron method for determining the deuterium content in liquid samples is described. The neutrons to be measured are produced by the reaction D(γ,n)H. The method proposed is more simple and rapid than the densitometric ones, but has the same accuracy. The effects of Cd, B, and Cl in the sample on the results of measurements are discussed. Author (NSA)

N68-31890# Aeronautical Research Labs., Melbourne (Australia).
THE CORROSION OF ZINC
K. F. Lorking May 1967 27 p refs
(ARL/MET-67) CFSTI: HC $3.00/MF $0.65

The corrosion of zinc has been studied in water and sodium hydroxide solutions, also over a wide pH range in decinormal solutions of sodium chromate, phosphate, benzoate, sulphate and chloride. Results showed that each anion has a specific effect. Analysis of corrosion processes on zinc has shown that the oxide film on zinc is not as protective or self-healing as that on aluminum. Some of the corrosion products formed by zinc may play a significant part in the formation of protective films which inhibit corrosion. Chromate is an excellent inhibitor of corrosion, appearing to form a protective oxide film on zinc. Author

N68-31899# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
THE ELECTROLYTIC DISSOLUTION OF PLUTONIUM IN NITRIC ACID
James W. Berry and Frend J. Miner 3 May 1968 9 p refs
(Contract AT(29-1)-1106)
(RFP-1136) CFSTI: HC $3.00/MF $0.65

The rate of dissolution of plutonium metal in nitric acid-fluoride systems using electrolysis was determined as a function of nitric acid concentration, fluoride concentration, and current density. Other parameters investigated included type of current and type of metal. The optimum conditions for rapid dissolution were found to be high nitric acid concentration (15.0M) and a high applied current (10 A). Fluoride concentration, over the range investigated (0.01 to 0.13M), was found to have little effect on the dissolution rate, although its presence is necessary. Analysis of the off-gases showed the hydrogen concentration to be near background concentration. Author (NSA)

N68-31908# Oak Ridge National Lab., Tenn. Chemical Technology Div.
MASS TRANSFER OF WATER FROM SINGLE THORIA SOL DROPLETS FLUIDIZED IN 2-ETHYL-1-HEXANOL
Sam D. Clinton Jun. 1968 112 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2163) CFSTI: HC $3.00/MF $0.65

The rate at which water is extracted from thoria sols was investigated by fluidizing single thoria sol droplets in 2 ethyl 1 hexanol and measuring the diameter of a droplet over a period of time until shrinkage no longer occured. Diameter data from both water and sol drops were obtained at 25°C. The experimental variables were drop diameter (0.1 to 0.2 cm), sol molarity (0 to 2.5 M ThO_2), and water concentration in the bulk solvent (2 to 12 mg of water per cc of solvent). A linear relationship was found for the water and sol droplet data. In this relationship, the Sherwood number was plotted against the product of Reynolds number raised to the 1/2 power and the Schmidt number raised to the 1/3 power. The common correlation for the fluidized water and sol drops verified a proposed mass transfer model, which assumes that an organic phase film surrounding the drop is the rate-controlling resistance. The sphere Reynolds number was based on an average organic fluidizing velocity and varied from 0.2 to 7. Author (NSA)

N68-31918# Ministry of Technology, Orpington (England).
MECHANISM OF THE VAPOUR-PHASE INTERACTION OF ALKANES WITH NITROGEN DIOXIDE. THE KINETICS AND CHEMICAL PECULIARITIES OF THE SLOW REACTION C_3H_8–NO_2
A. P. Ballod, S. I. Molchanovo, and V. Ya. Shtern Aug. 1968 15 p refs Transl. into ENGLISH from Neftekhim. (Moscow), v. 11, no. 1, 1967 p 115–123
(TIL/T-5757) CFSTI: HC $3.00/MF $0.65

Results are presented of investigations on the kinetics and chemical peculiarities of the slow nitration reaction between propane and nitrogen dioxide. The reaction was studied under static conditions. Author

N68-31921# Michigan Univ., Ann Arbor. Fluid Dynamics Lab.
THE PYROLYSIS OF TETRAFLUOROETHYLENE
George A. Drennan and Richard A. Matula Jan. 1968 21 p refs
(Grant AF-AFOSR-1144-67)
(Publ.-68-1; AFOSR-68-1200; AD-670836)

The pyrolysis of tetrafluoroethylene was studied in the temperature and pressure range 300 to 455C and 25 to 760 torr.

The rate of reaction was determined to be second order with respect to the tetrafluoroethylene, and three independent numerical values of the second order rate constant were determined by simultaneously measuring the tetrafluoroethylene concentration, the octafluorocyclobutane concentration and the total pressure as a function of reaction time. The temperature dependence of the reaction rate constants are given. Author (TAB)

N68-31922# Michigan Univ., Ann Arbor. Fluid Dynamics Lab.
THE THERMAL DECOMPOSITION OF PERFLUOROPROPENE
Richard A. Matula Feb. 1968 22 p refs
(Grant AF-AFOSR-1144-67)
(Publ.-68-2; AFOSR-68-1197; AD-670835)

The thermal decomposition of perfluoropropene in the temperature and initial pressure ranges 550 to 675C and 50 to 200 torr is discussed. The rate of decomposition of perfluoropropene is shown to be first order with respect to the perfluoropropene concentration. The first order rate constant is given. Author (TAB)

N68-31923# Aerojet-General Corp., Los Angeles, Calif. Center for Research and Education.
GENERAL METHOD FOR THE DIRECT SYNTHESIS OF THE CLOSO-CARBORANES: $C_2B_5H_7$, $C_2B_4H_6$, $C_2B_3H_5$, AND $C_2B_{10}H_{12}$
J. F. Ditter, E. B. Klusmann, and Robert E. Williams 12 Jun. 1968 14 p refs
(Contract Nonr-4381(00))
(TR-16; AD-670745)

Boranes and acetylene may now be converted directly, rapidly and simply in over 70% yield into the close-carboranes C2B3H5, C2B4H6 and C2B5H7 (from B5H9) and into C2B10H12 (from B10H14). Author (TAB)

N68-31924# Miami Univ., Coral Gables, Fla. Dept. of Chemistry.
MECHANISMS OF REACTIONS OF OXIDIZERS Annual Report, Period Ending 31 May 1968
A. G. Keenan 31 May 1968 5 p refs
(Contract Nonr-4008(07))
(AR-7; AD-670746)

Investigations of the synergistically catalyzed decomposition of oxidizers such as ammonium nitrate and ammonium perchlorate are briefly summarized. Research was done in the areas of thermal analysis, catalytic and mechanistic studies, and electrometric measurements. TAB

N68-31930# Tomorrow Enterprises, Portsmouth, Ohio.
INVESTIGATION OF TECHNIQUES FOR THE INTRODUCTION OF LIQUID SAMPLES INTO A PLASMA ARC FOR ALLOY ANALYSIS Technical Summary Report, 1 Dec. 1966–1 Dec. 1967
Louis E. Owen Apr. 1968 23 p refs
(Contract F33615-67-C-1320)
(AFML-TR-67-400; AD-670600)

Ultrasonic nebulization is the basis of a sampling sub-system developed for the introduction of liquid samples into a plasma arc for alloy analysis. A focusing piezoelectric transducer at 1.4 MH creates a fine uniform aerosol from solution samples held in a chamber. Acoustical energy is water-coupled to this chamber through a thin plastic film. Ultrasonic nebulization provides an efficient transfer of analyte to the discharge zone of plasma arc excitation devices. Pneumatic and electrostatic nebulization, also investigated, are inferior to ultrasonic nebulization for general application. In particular, ultrasonic nebulization is practical with solutions far too concentrated for other techniques. The sample aerosol produced by the instrument developed has possible application to other instrumental analytical techniques such as atomic absorption and flame spectrophotometry. Author (TAB)

N68-31935# IIT Research Inst., Chicago, Ill.
ADVANCED OXIDIZER CHEMISTRY Technical Summary Report, I Jul.–30 Sep. 1967
Irvine J. Solomon 17 Nov. 1967 24 p refs
(Contract AF 49(638)-1175)
(IITRI-C6125-21; AFOSR-68-1207; AD-670531)

The reaction of dioxygen difluoride (O2F2) with perfluoropropylene (C3F6) was shown to produce two new OOF compounds, CF3CF2CF2OOF and CF3CF(OOF)CF3. It appears that the OOF radical is transferred to carbon to produce these new compounds, which have been structurally characterized by F19 NMR and infrared spectroscopy and molecular-weight determinations. A large effort was expended in attempting to separate these isomers, but with no success. The reaction of oxygen fluoride (O2F) with nitrogen tetroxide (N2O4) at low temperatures yielded nitrosyl fluoride (FNO), nitryl fluoride (FNO2), and nitroxy fluoride (FONO2). However, it is not certain that FONO2 was formed by oxyfluorination, since it was also obtained from the reaction of fluorine (F2) with N2O4. FONO2 was also produced during the fluorination of sodium nitrite (NaNO2) and of potassium nitrate (KNO3). The F19 NMR spectrum of FONO2 exhibited a singlet at -200 ppm, relative to trichlorofluoromethane (CCl3F). Author (TAB)

N68-31943# Scottish Research Reactor Centre, East Kilbride.
PRODUCTION OF FLUORINE-18
J. E. Whitley [1968] 9 p refs
(SRRC-26/68)

Published methods for the production of ^{18}F are reviewed and an optimum procedure chosen for the conditions pertaining at the Reactor Center. Instructions are given for carrying out this procedure, and modifications suggested for those cases where the end-product is not in a form suitable for projected uses. Author (NSA)

N68-31945# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
NON-DESTRUCTIVE METHOD FOR THE DETERMINATION OF O/U RATIO IN SINTERIZED PASTILLES [METODO NON DISTRUTTIVO PER LA DETERMINAZIONE DEL RAPPORTO O/U IN PASTIGLIE SINTERIZZATE]
C. Ferro, S. Moretti, and C. Patimo 1967 18 p refs In ITALIAN; ENGLISH summary
(RT/ING(67)7) CFSTI: HC$3.00/MF$0.65

The aim of the work described was to set up a nondestructive method for the determination of O/U ratio in UO_2 ceramic fuels. For this purpose, e.m.f. measurements of solid electrolyte cells have been exploited. Two types of cells have been used: (1) Cu, Cu_2O/ZrO_2 CaO/Ni, NiO (2) Ni, NiO/ZrO_2 CaO/UO_{2+x} and e.m.f. measurements as a function of temperature have been performed. The former has been used for the calibration of the Ni, NiO reference electrode. The latter has been used to measure the molar partial free energy of oxygen in equilibrium with UO_{2+x}. Finally, the best temperature range, in which the measurements are more reproducible (750°C + 850°C); has also been determined. Author

N68-31948*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SERVOCONTROLLER FOR PROGRAMMING SAMPLE VAPORIZATION IN DIRECT CURRENT ARC SPECTROCHEMICAL ANALYSIS
William A. Gordon Washington Aug. 1968 32 p refs
(NASA-TN-D-4769) CFSTI: HC$3.00/MF$0.65 CSCL 07D

A method was developed for controlling atomic emission and sample vaporization in dc arc spectrochemical analysis. Automatic adjustments in arc current were made to cause the rate of atomic emission to follow a prescribed program. With a stabilized arc in argon the vaporization of silver chloride was repeatable to about 1 percent. The control system consisted of a spectrometer with multiplier-phototube detector, a curve-following programmer, a

controller, a dc current supply, and an argon arc chamber. The control system was used with a stabilized arc in argon and also with a wandering arc in air. Author

N68-31955# California Univ., Livermore. Lawrence Radiation Lab.
THE PRODUCTION OF PLUTONIUM METAL BY DIRECT REDUCTION OF THE OXIDE
W. Z. Wade and T. Wolf 22 Feb. 1968 16 p refs
(Contract W-7405-ENG-48)
(UCRL-50403) CFSTI: HC$3.00/MF$0.65

A single-unit process was developed for the rapid production of massive plutonium metal directly from its oxides. The process consists of the following steps: the reduction of plutonium oxides with calcium metal, extraction of the calcium oxide reaction product with molten calcium chloride, and the quantitative separation of the two immiscible molten-metal phases by the immiscible salt solution. Reduction, separation, and massive metal yield efficiencies are in excess of 99.98%; batch cycle time (completely independent of batch scale) is 15 min; and the single waste product is far below recovery level and is discardable as a small-volume solid waste. Author (NSA)

N68-31968# Explosives Research and Development Establishment, Waltham Abbey (England).
RECENT MEASUREMENTS OF THE THERMAL CONDUCTIVITY OF LIQUID ANHYDROUS HYDROGEN CHLORIDE
H. Ziebland and D. P. Needham 4 Jan. 1968 24 p
(ERDE-27/R/67; AD-669683)

The thermal conductivity of anhydrous hydrogen chloride was studied in a precision coaxial cylinder apparatus at temperatures between -75 and +65C, and pressures from 40 to 100 bar. The experimental results were correlated by means of the unique relationship between the density of a fluid and its thermal conductivity. A simple third order polynomial expression between these quantities was derived which not only satisfactorily correlated the experimental results, but may also be used for the prediction of the thermal conductivity over a limited range of density outside that covered by the experiments. Information derived from this investigation is summarized in three diagrams showing, respectively, the isotherms and isobars of the thermal conductivity, and the relation between the density and the thermal conductivity. Smoothed values of the thermal conductivity at integral values of pressure and temperature are presented in a table and are compared with previously published data derived from an application of the corresponding state principle. Author (TAB)

N68-31972# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung.
MIXED CRYSTAL FORMATION IN THE QUASIBINARY SYSTEMS OF UN AND THE MONONITRIDES OF GROUP IV-A TiN, ZrN, AND HfN [ZUR MISCHKRISTALLBILDUNG IN DEN QUASIBINAEREN SYSTEMEN VON UN UND DEN MONONITRIDEN DER IV A-GRUPPE TiN, ZrN, UND HfN]
H. Hollack, E. Smailos, F. Thuemmler Jan. 1968 11 p refs In GERMAN
(KFK-721)

The systems of UN with the nitrides of the IV-A transition metals Ti, Zr, and Hf behave completely analogously to the systems with UC: low solubility for TiN (TiC) and complete miscibility with ZrN (ZrC) and HfN (HfC). The critical miscibility temperatures can not be determined. Mixed phases with 50 mole % ZrN or HfN, which were annealed for 48 hr at 1050°C, showed no segregation phenomena. Two explanations are offered for the accelerated equilibrium attainment by U_2N_3 formation: (1) diffusion-preventing UO_2 films were destroyed during the intermediary U_2N_3 formation, so that the volume changes during the reaction can be the origin. It is known that sinter processes in UN are strongly inhibited by such films; (2) the UN is formed in the decomposition of U_2N_3 first in an active form which reacts directly during its formation. It was assumed that the first process has the greatest influence. Author (NSA)

N68-31991*# Astropower, Inc., Newport Beach, Calif.
DEVELOPMENT OF DESIGN CRITERIA FOR AN ELECTROCHEMICAL WATER RECLAMATION SYSTEM
J. P. Barry, H. K. Bishop, and G. A. Guter Aug. 1968 74 p refs
(Contract NAS1-7104)
(NASA-CR-66652) CFSTI: HC$3.00/MF$0.65 CSCL 07A

An experimental program was conducted to develop design criteria for an electrochemical system that will recover usable water from human urine on medium to long term space missions. This program was directed primarily toward the pretreatment of urine in an electrochemical cell to remove organic constituents. The effluent was then passed into an electrodialysis cell where most of the inorganic constituents were removed. The system processed nine pounds of urine in less than 16 hours and required less than 200 watt-hours per pound of water processed. Product water contained less than 500 ppm total dissolved solids and no measurable number of bacteria were present. Author

N68-31992# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
ATMOSPHERIC ABSORPTION BY CARBON DIOXIDE, WATER VAPOR AND OXYGEN Final Report
S. R. Drayson, S. Y. Li, and C. Young Feb. 1968 46 p refs
(Contract Cwb-11376)
(Rept.-08183-2-F; PB-178068) CFSTI: HC$3.00/MF$0.65

The carbon dioxide absorption bands between 12 and 18 microns are of great importance for atmospheric long wave radiative transfer. Theoretical calculations require an accurate knowledge of the frequencies, intensities and half-widths of the individual absorption lines. The method of calculating the frequencies and relative intensities is described, including tables of the necessary parameters. Band intensities and half-width are deduced from high and low resolution experimental spectra. Comparisons between the experimental and theoretical data are presented, showing generally satisfactory agreement. Also presented are the results of partially completed studies of the rotational water vapor band and the oxygen 'A' band. Author (USGRDR)

N68-31993# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie.
METHODS AND RESULTS OF RADIOCHEMICAL RANGE INVESTIGATIONS [METHODIK UND ERGEBNISSE RADIOCHEMISCHER REICHWEITE-UNTERSUCHUNGEN]
Helmut Muenzel Dec. 1967 80 p refs In GERMAN
(KFK-693)

A bibliographic review is made of the methods and results of radiochemical range investigations. The principle of the method and variations on it are described in detail. The equations necessary for evaluation of the experimental results are given. A range-energy relation is derived for the universal application of this method to the study of nuclear reactions. The results of radiochemical range studies are reported. These include verification of the statistical model, studies with direct reactions, and investigations on nuclear fission. NSA

N68-31994# National Institutes of Health, Bethesda, Md. Translating Unit.
THE SYNTHESIS OF SOME DEUTERATED AROMATIC HYDROCARBONS AND THEIR RAMAN SPECTRA
A. I. Shatenshtein, G. V. Peregudov, E. A. Izrailevich, and V. R. Kalinschenko Dec. 1967 10 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 32, no. 1, 1958 p 146-151
(NIH-12-4-67; PB-176880T) CFSTI: HC$3.00/MF$0.65

The employment of hydrogen exchange with liquid ND3 and DBr for preparation of completely and partially deuterated aromatic hydrocarbons is described, and the characteristics of the deuteration with a number of solvents are considered. The spectra of the Raman effect of the following substances were measured: C6D6, C10D8, C12D10, C6D5CD3, 1,4,5,8-C10D4H4, 2,3,6,7-C10D4H4, 2,4,6,2',4',6'-C12D6H4 and 3,5,3',5'-C12D4H6. Author (USGRDR)

N68-32015# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE ROTATION-INVERSION SPECTRUM OF AMMONIA
J. M. Dowling Mar. 1968 25 p refs
(Contract F04695-67-C-0158)
(TR-0158-9260-01-5; SAMSO-TR-68-204; AD-670825)

The rotation-inversion spectrum of ammonia (NH3) was observed in the wavenumber region between 35/cm and 240/cm, with a resolution of approx. 0.08/cm. The K splitting (due primarily to centrifugal distortion) is extensive, and many lines due to single transitions are observed. The best resolved of these unblended lines are used in a rotational analysis. Author (TAB)

N68-32017*# Techtran Corp., Glen Burnie, Md.
SOME OXIDATION CHARACTERISTICS OF CARBON-GRAPHITE MATERIALS [O NEKOTORYKH OSOBENNOSTYAKH OKISLENIYA UGLEGRAFITOVYKH MATERIALOV]
G. M. Volkov, V. I. Kalugin, and I. A. Fayzullin Washington NASA Aug. 1968 6 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 13, no. 4, 1967 p 438–442
(Contract NASw-1965)
(NASA-TT-F-11874) CFSTI: HC$3.00/MF$0.65 CSCL 07B

The features of the interaction of synthetic graphites with oxidizing agents are examined and a method for isolating the effect of the physical and chemical factors is proposed. Experimental data on the differentiated determination of the loss rate of a graphite mass during oxidation by atmospheric oxygen are given. Author

N68-32039# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN ANALYTICAL INVESTIGATION OF PLUTONIUM OXIDE
Franklin L. Oetting and Yvonne M. Ferris 10 May 1968 5 p refs
(Contract AT(29-1)-1106)
(RFP-1122) CFSTI: HC$3.00/MF$0.65

An analysis of plutonium in 36 samples of scrap plutonium oxide, each weighing approximately one kilogram, has been performed. Each sample was investigated by four separate analyses. Wet chemical analyses were performed on three of the samples taken from different locations within the container of plutonium material. The fourth analysis was a calorimetric technique which nondestructively analyzed the complete contents of the container. The results of all analyses were compared. Author (NSA)

N68-32075# Forsvarets Forskningsanstalt, Stockholm (Sweden).
HYDRAZINE CATION RADICAL FORMATION IN γ IRRADIATED SINGLE CRYSTALS OF HYDRAZINIUM HYDROGEN OXALATE
O. Edlund, A. Lund, and A. Nilsson 1968 21 p refs
(LF-21; NP-17484)

Single crystals of hydrazinium hydrogen oxalate, $N_2H_5HC_2O_4$, were irradiated at room temperature in a ^{60}Co gamma source to doses between 3 and 20 MRAD. The ESR spectra of the hydrazine cations formed were recorded with a spectrometer. The complex was found to be planar with the unpaired electron delocalized over the two N nuclei. The radical has a different orientation in the crystal compared with that of the parent ion. NSA

N68-32096# Portugal. Nuclear Energy Commission, Sacavem. Chemical and Metallurgical Div.
ANALYTIC STUDY OF MIXTURES OF OXYGENATED WATER, PERMONOSULFURIC ACID AND PERDISULFURIC ACID. HYDROLYSIS OF PERSULFURIC ACIDS [ESTUDO ANALITICO DE MISTURAS DE AUGUA OXIGENADA ACIDO PERMONOSULFURICO E ACIDO PERDISULFURICO. HIDROLISE DOS ACIDOS PERSULFURICOS]
M. Helena 1967 28 p In PORTUGUESE
(DOC-LFEN-75; Q-37/QR-11)

Solutions of persulfuric acids were studied to determine the effects of the addition of peroxide, hydrogen, and oxygenated water. Studies with various ferrous sulfates were concerned with both the effects of dissolved oxygen and hydrolysis in solutions. Concentration effects of these additions were investigated, as were arsenic and cerium in the persulfuric acids. The process used to perform these experiments is described, and numerous tables and graphs summarize the results obtained. Transl. by M.W.R.

N68-32097# Portugal. Nuclear Energy Commission, Sacavem. Div. of Chemistry and Metallurgy.
STUDY OF THE CHEMICAL EFFECTS OF (n γ) REACTION IN HEXACHLORIDE (4) CRYSTALS [ESTUDO DOS EFEITOS QUIMICOS DA REACCAO (n,γ) EM CRISTAIS DE HEXACLOROIRIDATO (4)]
J. M. Peixoto Cabral (Ph.D. Thesis—Lisbon Univ., 1966) 1967 83 p refs In PORTUGUESE; ENGLISH summary
(LFEN-78(γ)) CFSTI: HC$3.00/MF$0.65

Electrophoreses on several hexachloride crystals (IV) in aqueous solutions were conducted to determine changes in chemical bonding during (neutron, gamma reactions); and attention was given to the recombination of chemical bonds broken because of radiative capture by thermal neutrons. Various collision and fragmentation models are included, and the influence of atomic structure on changes in irradiated solids was investigated. Comparison of results with hydrated and anhydrous crystals indicated that some reaction reduction reactions occurred in the $Na_2IrCl_6.6H_2O$ crystals between the recoil fragments and the water or water-derived molecules. The presence of water molecules in the crystals inhibited recombination reactions between recoil fragments and negative chlorine ions. In the $(NH_4)_2IrCl_6$ crystal, some reduction reactions occurred between the recoil fragments and species derived from the ammonium ion. Experimental results with potassium crystals are also included, and irradiation effects were studied. Transl. by M.W.R.

N68-32109# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
EVALUATION OF A GAS MIXING SYSTEM
Robert P. De Grazio and Robert G. Auge 23 May 1968 9 p refs
(Contract AT(29-1)-1106)
(RFP-1143) CFSTI: HC$3.00/MF$0.65

Because of the need to obtain standard gas mixtures in concentrations ranging from parts per million to percent for infrared and gas chromatographic analysis, a gas mixing apparatus was developed. To evaluate its capability, the apparatus was used to prepare mixtures of different concentrations of gases. The mixed gases were analyzed by gas chromatography and infrared spectroscopy. The results of the analyses of the prepared mixtures were then compared statistically with standard mixtures of the same gases obtained commercially. The comparison of these analyses showed that the apparatus can effectively and reproducibly prepare gas mixtures over the ranges studied. The apparatus is described and the precision and accuracy data are presented. Author (NSA)

N68-32188*# Illinois Univ., Chicago. Chemistry Dept.
THE FORMATION OF 3,6-DIPHENYLPYRIDAZINE AND 2,5-DIPHENYLPYRROLE FROM α-STYRYL AZIDE
J. H. Boyer, W. E. Krueger, and R. Modler [1967] 5 p refs
(Grant NGR-14-012-004)
(NASA-CR-95953) CFSTI: HC$3.00/MF$0.65 CSCL 07C

Two new thermal reactions of neat α-styryl azide have been observed. After one month at room temperature in a tightly closed screw-cap brown glass bottle, 21.0 g. (0.14 mole) of neat α-styryl azide is transformed into 2-phenylazirine (ca. 10%).

3,6-diphenylpyridazine, m.p. 221–223°C, 0.7 g. (0.003 mole) (7%) and 2,5-diphenylpyrrole, m.p. 137.5-141.5°C, 3.0 g. (0.013 mole) (32%). Yields are based on 8.5 g. (0.06 mole) (40%) recovered α-styryl azide. Each day the bottle was opened to allow accumulated gas to escape. Neither 2,5-diphenylpyrazine, nor its 3,6-dihydroderivative, the known dimer of 2-phenylazirine, (or its valence tautomer, α-styrylnitrene), was detected. Author

N68-32189*# Notre Dame Univ., Ind. Dept. of Chemistry.
POLYMERIC SCHIFF BASES. 16. ALTERNATE SYNTHESES FOR THE IMINOBENZYLIDENE POLYMERS
G. F. D'Alelio, F. R. Meyers, W. F. Strazik, and R. L. Germonprez [1968] 18 p refs
(Grants NsG-339; NGR-15-004-028)
(NASA-CR-95969) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Eight monomers, considered as suitable for the direct synthesis of iminobenzylidene polymers, $[NC_6H_4CH]_n$, which pass through a tractable, fusible stage, have been synthesized. The polymerization of four of these monomers yielded insoluble, infusible brick-dust polymers. With the exception of $p\text{-}CH_3CONHC_6H_4CHO$ and $p\text{-}C_6H_5CH = NC_6H_5CH = NC_6H_5$ little advantage accrues to the use of these new monomers in the synthesis of the desired polymers, which appear to be best prepared by polymerizing the trimers and m- and p-aminobenzaldehyde in solution of benzylideneaniline. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-30885 Florida Univ., Gainesville.
RADAR SIGNAL DESIGN FOR OPERATION IN AN EXTENDED TARGET ENVIRONMENT
Philip Clark Dickinson (Ph.D. Thesis) 1966 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-12919

Examples are given for a rectangular scattering function which illustrate the loss of system performance that exists if a target is overspread. Available signal-to-noise ratios are calculated for an altimeter and a collision avoidance radar for three different systems and normalized curves are plotted. These results provide crude but useful bounds on the operation of radars in extended target environments. This report extends the concept of the target scattering function to an airborne radar situation. A cross-ambiguity function is defined which applies to both cw and pulse radars and the system response is shown to be the convolution of the target scattering function with the radar ambiguity function. Examples are included which demonstrate the general superiority of pulse radars for those applications in which clutter is a problem. Dissert. Abstr.

N68-30900 California Univ., Berkeley.
TRANSMISSION-LINE MODEL OF THE PLANAR EQUIANGULAR SPIRAL ANTENNA
Darko Kajfez (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-11636

An attempt is made to analyse the planar equiangular spiral antenna by using the equivalent circuit which is composed from distributed inductances and capacitances. The equivalent circuit is represented in a form of a lossless multiconductor transmission line of spiral shape. The analysis of this circuit shows that the currents and voltages on conductors can be represented in a form of a sum of many modes with distinct propagation constants. As the equivalent circuit is assumed to be lossless, the direct application of this multiconductor transmission line model is limited to the input region of the spiral antennas where the radiation losses are not significant. The Thesis includes an evalustion of: the inductance and capacitance matrices, the propagation constants, and the amplitudes of the individual modes for different types of initial conditions. The input impedance of a spiral antenna is computed as that of a long multiconductor line containing a minimum of reflected power. The formalism used to solve the multiconductor model can be applied to spirals of any number of arms; specifically, the examples of two- and four-arm spirals are worked out in detail. The computer programs are listed in the appendix. Dissert. Abstr.

N68-30908 Colorado Univ., Boulder.
FADING CORRELATION OF HIGH FREQUENCY SIGNALS PROPAGATED THROUGH THE IONOSPHERE
William Frederick Utlaut (Ph.D. Thesis) 1967 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-10018

Owing to the changing nature of the propagation medium and interference between waves which have traveled along different paths in arriving at a receiver, the received signal amplitude fluctuates or fades. The fading of signals on adjacent frequencies tends to be different and this phenomenon of selective fading is one of importance for high frequency communication. Correlation between the amplitudes of fading high frequency radio waves, in relation to propagation factors and as a function of the frequency separation between the waves, is studied in this analysis. A basic problem in the investigation of signal transmission in any system is that of relating the parameters of the output signal to those of the input signal and the transmission characteristics of the system. A time-varying linear network model for ionospheric propagation is developed and used for the fading correlation analysis here. With the model, it is possible to determine the fading correlation in terms of the amplitude structure of the signal time-delay spread and Doppler frequency spread resulting from the multipath propagation through the ionosphere. Dissert. Abstr.

N68-30919 Colorado Univ., Boulder.
A CORRELATION PHASE DETECTOR
Clarence Herndon Stewart (Ph.D. Thesis) 1968 149 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-10086

The determination of the angle of arrival of a plane wave impinging on a pair of antennas is a problem of some importance in the field of electrical engineering. An ad hoc solution to the phase extraction problem associated with monopulse systems was postulated, analyzed and investigated experimentally. Although the experimental effort emphasized monopulse phase extraction techniques, the technique is directly applicable to signals of a more continuous nature. This phase extraction technique represents an original contribution to a problem of some significance in monopulse system design. The principal contribution lies in the use of linear combinations of the outputs of two correlation detectors to generate a multiplicity of psuedo cross-correlation functions which are simultaneously quantized to generate a non-ambiguous code over the interval $(0, 2\pi)$. The significance of the basic contribution can best be illustrated by a comparison of the performance of the experimental phase detector with that of phase detectors previously employed in a monopulse system. At matched bandwidth signal-to-noise ratios of zero db, prior phase detectors produced r.m.s. errors of 30 to 35 degrees. At this same signal-to-noise ratio the correlation phase detector had an r.m.s. error of less than one degree. Dissert. Abstr.

N68-30937 Boston Univ., Mass.
THE EFFICIENCY OF SOME NONPARAMETRIC TESTS IN THE DETECTION OF A STOCHASTIC SIGNAL IN NOISE
Richard Arthur Groeneveld (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-13266

The problem considered is the detection of a stochastic signal in noise. The inputs to m receivers are compared in order to test the hypothesis that a signal common to the m inputs is present. The observation at time t in the ith receiver is assumed to be of the form $X_i(t) + S(t)$, if the signal is present, or $X_i(t)$, if not, $i = 1, 2,...m$. The X_i and S are mutually independent random variables with zero mean representing the noise in the ith channel and the signal respectively. A test is to be based on n observations taken from each receiver at equally spaced time points. The observation in the ith receiver at time j is denoted u_{ij}. We consider the detection problem in the case that the signal and noise variables are permitted to have any continuous distribution. Nonparametric tests recommend themselves under this general assumption. Dissert. Abstr.

N68-30971# White Sands Missile Range, N. Mex. Data Reduction and Computing Working Group.
IRIG STANDARD FOR DISTRIBUTING VECTOR ACQUISITION DATA
Dec. 1967 13 p
(DR/CWG-104-67; AD-671045)

The document defines a standard procedure for distributing vector acquisition data to remote tracking instruments. The standard procedures set forth herein are recommended, where applicable, for interchange of acquisition data among the National and Service Ranges and other ranges associated with IRIG. This standard does not apply to the distribution of raw radar data. Author (TAB)

N68-30972# Pennsylvania State Univ., University Park. Ordnance Research Lab.
AN INVESTIGATION OF THE PROPERTIES OF THE ENVELOPE ENERGY OF AN AMPLITUDE MODULATED NOISE CARRIER
E. D. Zorawowicz Aug. 1967 46 p refs
(Contract Now-65-0123)
(TM-203.3361-11; AD-671043)

The probability distributions of the amplitude of the envelope energy spectrum of both Gaussian noise and amplitude modulated Gaussian noise are derived. From these probability distributions the probability of detection of the modulation is calculated by comparing the distribution at the modulating frequency to the distribution at an adjacent frequency. Confidence percentages as a function of modulation factor are also calculated and compared with experimental results. Author (TAB)

N68-30974 Polytechnic Inst. of Brooklyn, N. Y.
OPTIMUM RADAR SIGNAL PROCESSING IN CLUTTER
Lloyd J. Spafford (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13421

The joint optimization of signal and filter in a given clutter-noise environment was considered in order to obtain an optimum radar signal processor. The criterion used for this joint optimization is maximum probability of detection for a given value of false alarm probability. Results indicate that both signal and filter design are important when the clutter is stationary or extended in range if improved clutter performance is to be obtained; however, when the clutter is not extended in range, improved performance may be possible with filter design alone. It is shown that one family of signals suitable for improved performance in clutter is the uniformly spaced envelope recurrent pulse train. The analysis is predicated upon the assumption that the clutter environment is known. For practical situations, when this assumption does not hold, an adaptive filter that automatically senses the clutter distribution and provides the optimum filter function for a given transmitted signal is proposed. Dissert. Abstr.

N68-31016 California Univ., Los Angeles.
SIMULTANEOUS REDUCTION OF CONVARIANCE OPERATORS, AND THE NOISE-IN-NOISE PROBLEMS OF COMMUNICATION THEORY
Charles Ray Baker (Ph.D. Thesis) 1967 67 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-14291

This dissertation treats several topics related to the noise-in-noise problems of communication theory. In each case, the problem setting is a real, separable, infinite-dimensional Hilbert space, H, and involves the use of covariance operators (operators mapping H into H which are bounded, linear, self-adjoint, non-negative, and trace class). The first problem considered is the following: Determine conditions on covariance operators R_1, R_2 which are necessary and/or sufficient for the existence of a set of elements $\{e_n\}$ in H, complete for H, that satisfy $R_1 e_n = \lambda_n R_2 e_n$ for each element of $\{e_n\}$, with $\{\lambda_n\}$ a bounded set of real scalers. Such a representation is called a complete simultaneous reduction (CSR) for R_1 and R_2. The existence of a CSR can be a substantial aid in solving several of the noise-in-noise problems of communication theory. The problem of maximizing the deflection of a quadratic test statistic for two random processes (one being Gaussian) whose sample elements belong to H is solved, and necessary and sufficient conditions for the deflection to be bounded are obtained. Dissert. Abstr.

N68-31026# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France). Div. Satellites.
PFM: ORTHOGONAL TELEMETRY SYSTEM [LA PFM: SYSTEME DE TELEMESURE ORTHOGONAL]
P. Debray 11 Mar. 1966 16 p refs In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Definition is given of orthogonal codes and their decoding is analyzed. Error probability is discussed. Application to pulse frequency modulation is indicated. ESRO

N68-31040# Centre National d'Etudes Spatiales, Paris (France). Div. des Etudes et Developpements Techniques.
INTRODUCTION TO THE TELEMETRY [INTRODUCTION AUX TELEME SURES]
J. Taramazzo [1968] 11 p refs In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Shannon theorem is presented and applied to time and to frequency division multiplexing. Analog and digital telemetry systems are compared, and the quantity of information carried by the signal in the unit time is evaluated. ESRO

N68-31122# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France). Div. Mathematiques et Traitement.
OPERATIONAL PROCESSING OF DIANE TRACKING STATION DATA [LE TRAITEMENT OPERATIONNEL DES DONNEES DIANE]
J.-C. Blaive Feb. 1967 31 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Principles of interferometric measurements are recalled and their accuracy is analyzed. It is shown how to compute orbital elements taking into account perturbations introduced by sun and moon influences, earth gravitational field, atmospheric friction and radiation pressure. Data smoothing at Diane stations is described. ESRO

N68-31193# Raytheon Co., Wayland, Mass. Equipment Div.
DOPPLER SIGNAL ANALYSIS AND PROCESSING TECHNIQUES FOR MODIFIED PORCUPINE C-BAND PULSE DOPPLER RADAR Final Report, 1 Jan. 1967–28 Feb. 1968
Toby Berger, Edward E. Cox, Herbert L. Groginsky, Joseph M. Kovalik, Harvey Siegel et al 29 Feb. 1968 147 p refs
(Contract AF 19(628)-4774)
(AFCRL-68-0176; AD-670546)

The report deals primarily with various doppler signal processing techniques for the Porcupine Weather Radar System. Continuing emphasis is placed on digital data reduction techniques including the fast Fourier transform method of spectral analysis. Practical methods of handling the vast amounts of data gathered by the Coherent Memory filter are discussed. Initial work on the computer analysis of the Velocity Azimuth Display including program documentation is also included. Author (TAB)

N68-31228# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES. 1968 MARCH
R. D. Eberst 6 May 1968 16 p
(ROE-STS-75) CFSTI: HC$3.00/MF$0.65

Stopwatch observations made at stations connected with the Section during the month of 1968 March are listed in satellite launch order and in time order for each satellite. Various sub-totals are given. Author (ESRO)

N68-31230# Société Anonyme de Télécommunications, Paris (France).
FM/FM TELEMETRY. PART 1: FUNDAMENTAL PRINCIPLES AND PRIMARY PROPERTIES [LES TELEMESURES FM/FM. PARTIE 1: PRINCIPES FONDAMENTAUX ET PROPRIETES ESSENTIELLES]
Greneche Mar. 1967 40 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC$3.00/MF$0.65

Frequency division multiplexing systems based on frequency modulation are discussed. Basic principles and theoretical characteristics of the systems are recalled. Standard transmission characteristics are analyzed in relationship with passbands. ESRO

N68-31233# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France). Div. Satellites.
PCM TELEMETRY SYSTEM [SYSTEME DE TELEMESURE PCM]
J. P. Bourdeau 14 Mar. 1968 55 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC$3.00/MF$0.65

A description of the system is given with special attention to analog and digital data and analog to digital converters. Different codes used are listed and explained. ESRO

N68-31239# Selenia S. P. A., Rome (Italy).
ELDO INITIAL PROGRAM: RADIO FREQUENCY INTERFERENCE. ELDO VEHICLE ANTENNA PATTERNS, VOLUME 1: INTRODUCTION AND WREBUS AERIALS
Paris ELDO 9 Jun. 1967 89 p
(ELDO-RFI-5; APP. 1, V. 1) CFSTI: HC$3.00/MF$0.65

A list of ELDO launch vehicle antenna patterns in the different configurations of the flight is given. Data sheets are presented for Wrebus aerials. ESRO

N68-31256# Air Force Cambridge Research Labs., Bedford, Mass.
THE DETERMINATION OF ANTENNA PARAMETERS BY THE USE OF EXTRATERRESTRIAL RADIO SOURCES
A. A. Guidice and J. P. Castelli Apr. 1968 44 p refs *Its* Phys. Sci. Res. Papers No. 357
(AFCRL-68-0231; AD-671117)

In the last ten years, vast improvements in technology and instrumentation have allowed radio astronomy to go beyond the stage where its measurements were principally of interest to pure science (astronomy, astrophysics, cosmology, etc.) to a stage today where such measurements have important practical application in the fields of communications, radar, and antenna systems. This report covers the application of extraterrestrial radio sources, whose emission properties (flux density, spectrum, celestial position, angular size, etc.) have been firmly established by careful radio-astronomical observations, to the determination of antenna parameters. The extraterrestrial radio sources whose properties are presented are the sun, the moon, and the strong discrete (celestial) radio sources. The areas of application discussed in detail are the determination of antenna gain, effective area, and aperture efficiency and the measurement of the power pattern of an antenna. Another application briefly discussed is the measurement of effective radiated power from satellites. Author (TAB)

N68-31264*# Auburn Research Foundation, Inc., Ala.
THE ANALYSIS AND DESIGN OF AN ELLIPTICALLY POLARIZED, CAVITY BACKED, CROSSED-SLOT ANTENNA
E. R. Graf 25 Apr. 1967 49 p refs
(Contract NAS8-20557)
(NASA-CR-95939; TR-2) CFSTI: HC$3.00/MF$0.65 CSCL 09F

The electromagnetic field and polarization characteristics of a crossed-slot antenna are analyzed through the application of Babinet's principle to the dipole antenna. A unique feed system is used to obtain the necessary slot excitation to produce an elliptically polarized wave. It requires a minimum number of components and is suited for large arrays. The crossed slots are excited by two orthogonal modes in a resonant cavity of square cross section. The two modes are excited by two loops magnetically coupled to the cavity at a magnetic field maximum, with a conducting stub located between the loops for coupling and tuning purposes. One of the loops is excited by a coaxial feed, and the second loop is excited parasitically by coupling between the loops and through the conducting stub. The polarization ellipticity and input impedance of the element is dependent upon the penetration of the conducting stub and may be adjusted to obtain low voltage standing-wave ratios and polarizations of small ellipticity. Design considerations and physical characteristics of the antenna are presented together with calculated and measured polarization and azimuth patterns. Author

N68-31266# Harvey Aluminum, Torrance, Calif.
IMPROVED MIDFED WHIP ANTENNA, PHASE 2 Final Engineering Report, 16 Aug. 1965–15 Jun. 1967
15 Jun. 1967 159 p ref
(Contract N140(70024)-77473B)
(AD-865004)

A final report is made of a program to develop and fabricate four improved Midfed Whip Antennas from titanium. The report describes efforts expended during the second phase of a two-phase program, and it describes fabrication of the four titanium antenna masts to parameters established during Phase I. TAB

N68-31289# Naval Research Lab., Washington, D. C. Microwave Antennas Components Branch.
A MATRIX-FED CIRCULAR ARRAY FOR CONTINUOUS SCANNING Interim Report
B. Sheleg 2 Apr. 1968 33 p refs
(NRL-6696; AD-671052)

If the radiators of a circular array are connected to the outputs of a Butler matrix, a focused radiation pattern can be formed by establishing the proper current distribution on the inputs of the Butler matrix. Further, if the amplitudes of the input currents

are held fixed, the pattern can be scanned through 360 degrees in azimuth by the operation of phase shifters alone, just as the pattern of a linear array is scanned by varying the phases of the element currents. One explanation of this is based on the assumption that the pattern can be written as the sum of a finite number of uniform pattern modes and that the relative phases and amplitudes of these modes can be adjusted to form a narrow beam. Then the beam is scanned by adjusting the currents feeding the Butler matrix. This is only qualitatively correct: the patterns calculated from the actual current distribution established on the array by the matrix differ from the patterns formed from the ideal modes. There is reasonable agreement between the calculated patterns and those obtained experimentally with a 32-element array of dipoles used to demonstrate how a beam could be formed and then scanned. The inputs to the Butler matrix required to achieve a prescribed cophasal sector distribution on the array are determined from the synthesis procedure of Davies with the corresponding changes in the current distribution on the array for other beam positions. Author (TAB)

N68-31296*# Auburn Univ., Ala. Engineering Experiment Station.
A PHASE STABILITY STUDY SYSTEM FOR VLF PROPAGATION OVER SHORT DISTANCES
E. R. Graf 26 Jul. 1968 164 p refs
(Contract NAS8-20154)
(NASA-CR-61922; TR-1) CFSTI: HC $3.00/MF $0.65 CSCL 17B

An engineering design of a unique transponder system for the phase measurement of VLF signals is developed and evaluated. The phase measurement over a two-way path, which is performed by the system is independent of the incidental phase errors of the associated transmission equipment and is a result of phase-coherent system design. The system design reviews the basic fundamentals of the propagation of electromagnetic energy within the earth-ionospheric cavity for short distances. The required power and the signal-to-noise ratio for the proposed propagation system are investigated. The effect of a finite ground conductivity on the over-all propagation in this region is also explored. An engineering design of the system, which meets the requirements for the phase stability measurements, is presented. An antenna design technique for obtaining increased static antenna capacitance of an umbrella antenna with negligible decrease in effective height is presented. The antenna design employs a multiple wire construction which effectively increases the surface area of the antenna rib and, thereby, the total antenna capacitance. The system construction, which consisted basically of two 300 ft umbrella antennas and their associated equipment, is described. In addition, a computer-aided technique for SNR measurement employing a time interval counter is presented. This technique yields a measure of the period of the signal-plus-noise in a digital form. This digital data can be recorded along with the phase stability data on magnetic tape, and the SNR can be monitored almost continuously to indicate phase measurement accuracy. Author

N68-31326*# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
AROD TEST MODEL HARDWARE, VOLUME 1 Final Report
1 Jul. 1967 140 p refs
(Contract NAS8-11835)
(NASA-CR-61899; AC-F-3065-3, V. 1) CFSTI: $3.00 CSCL 09F

An overview is presented on the airborne range and orbit determination (AROD) program for developing test model hardware compatible with space performance requirements. Microminiature packaging techniques, integrated circuitry, and hardware optimization methods were used, and integrated circuitry was applied to the radio frequency signal processing equipment. The major problems encountered and the solutions which evolved are discussed. Data are provided on the developmental vibration test, the pressure test of the AROD base plate, thermal mock-up test results for the vehicle-borne AROD unit, and reliability analyses of both the vehicle-borne and the ground station equipment. Performance characteristics are discussed in terms of initially specified values, analytically estimated parameters, measured characteristics, and technical accomplishments relative to automatic, unmanned, narrow-band communication or range measuring equipment. It is concluded that the AROD concept for accurate, real-time, automatic data measurement from a spacecraft, using unmanned remotely located transponder stations, can be realized with the AROD test model hardware design. M.G.J.

N68-31327*# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
AROD TEST MODEL HARDWARE, VOLUME 2 Final Report
1 Jul. 1967 306 p refs
(Contract NAS8-11835)
(NASA-CR-61900; AF-F-3065-3, V. 2) CFSTI: $3.00 CSCL 09F

Detailed design data and test results are presented on the subsystems comprising the airborne range and orbit determination (AROD) equipment which is packaged in two cases. Within these cases, the subsystems are roughly divided into frames, with the circuitry packaged mainly in modules; in some cases, the components are mounted directly to open boards. Case construction is described. The engineering data provided pertain to (1) the station control transmitter, which is the VHF link between the vehicle and ground stations; (2) the data modulator; (3) the tracking transmitter which is the S-band link between the vehicle and ground stations; (4) the vehicle tracking receiver; (5) the frequency synthesizer; (6) the data measurements subgroup which contains the data extraction logic for the AROD system; (7) the vehicle system control logic for controlling the acquisition and release of ground stations; (8) the dc to dc power converter; and (9) the vehicle transmitter code control for generating the ranging code that is transmitted to the ground station, and supplying accurate timing signals to other subsystems. M.G.J.

N68-31328*# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
AROD TEST MODEL HARDWARE, VOLUME 3 Final Report
1 Jul. 1967 180 p ref
(Contract NAS8-11835)
(NASA-CR-61901; AC-F-3065-3, V. 3) CFSTI: $3.00 CSCL 09F

Engineering design concepts are presented on the transponder station whose function is defined as receiving, translating, and retransmitting signals containing a ranging code from an airborne range and orbit determination (AROD) vehicle. To achieve the objectives of automatic acquisition and tracking, thus allowing the use of unmanned ground stations, two receivers are used: (1) The VHF receiver for rapid acquisition and station control receives a 138 MHz PSK/PM/PM signal containing all instructions for the transpondar. (2) The S-band station tracking receiver receives a 2214 MHz PN/bi-phase modulated signal and the transmitter retransmits the same code at 1800 MHz. To maximize reliability, components were chosen to operate at 25% of their voltage, current, or power ratings unless constrained by other factors; integrated circuits were used when practical. Detailed functional descriptions are provided on the data demodulator, station control logic, power amplifier, and power converter. The test equipment developed for AROD vehicle checkout and transponder checkout is also described. M.G.J.

N68-31329*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
AROD LABORATORY TEST AND EVALUATION PROGRAM Final Report
10 Aug. 1967 119 p
(Contract NAS8-11835)
(NASA-CR-61897; AC-F-3065-7) CFSTI: $3.00 CSCL 09F

The test program undertaken to determine the performance characteristics of the airborne range and orbit determination (AROD) system is detailed. The tests were designed to simulate all normal operating conditions, to provide for statistical evaluation of delay and acquisition measurements under a variety of signal conditions.

and to demonstrate fully automatic operation in acquisition and sequencing of the transponder stations. The evaluations of vehicle receiver and transmitter were carried out under vacuum conditions to determine the need for pressurization, and to verify that the heat transfer characteristics were satisfactory. Single channel test data cover acquisition thresholds and times, range and velocity measurements, and tracking characteristics at various signal levels; multiple channel data assesses the effects on range and range rate measurements of jamming due to varying signal level and Doppler conditions. Bit error tests of the S-band data link are included. The long term effects of drift and aging are examined. Details are given on the Doppler reverse system in AROD, and on the velocity measurement problems encountered. System improvements for AROD are recommended. M.G.J.

N68-31343*# Auburn Univ., Ala.
ANALYSIS AND OPTIMIZATION OF AN OMNI-DIRECTIONAL DIRECTION FINDING SYSTEM
E. R. Graf 15 Dec. 1967 91 p refs
(Contract NAS8-20557)
(NASA-CR-95940; TR-3) CFSTI: $3.00 CSCL 09F

A direction finding system that derives the direction cosines of the direction of arrival of a radio frequency signal has been presented. Since the direction finding antenna must be omnidirectional and must respond to a signal of any given polarization, the antenna should consist of a vertical and a horizontal ring. Although the use of two rings necessitates the use of two feed systems, it was decided that this is the best method of fulfilling the specified directional characteristics and polarization requirements. In light of the low frequency of operation, it is believed that the elements used in the direction finding array are optimum. Although the multicouplers employed in the feed system function properly in generating the sequence voltages, they have the undesirable characteristic of power dissipation in the isolation resistors. These multicouplers are the best available at the present time, and future work on a similar feed system should be directed towards finding a multicoupler that does not dissipate any power. The method of normalizing the sequence voltages originated with this study should allow accurate direction information to be obtained. Author

N68-31345 Pennsylvania Univ., Philadelphia.
PROCESSING METHODS AND BASIC LIMITATIONS OF MULTIPLE TARGET MONOPULSE RADAR
Peyton Zimmerman Peebles, Jr. (Ph.D. Thesis) 1967 272 p
Available from Univ. Microfilms: HC $12.40/MF $3.50 Order No. 67-12790

The concept of multiple target monopulse radar is treated in an analysis of the noise-free problem, as well as accuracy when noise is present. The noise-free case considers the determination of the parameters of amplitude, phase angle, and angular positions associated with multiple targets when only a single return signal from each target is available (monopulse). The assumptions made that make the problem interesting are that the targets all lie in the same range-doppler-angle-angle resolution cell defined in the normal sense. The procedure explored is that of simultaneous processing of both in-phase and quadrature-phase signals obtained from the outputs of multiple beams, which are represented by Taylor series expansion. Accuracy, when noise is present, is considered by applying the Cramér–Rao inequality for the minimum variance of unbiased estimators when several unknown parameters are present. A simple derivation of the inequality is given and a new method of developing the expressions for the minimum variance estimators is presented. Dissert. Abstr.

N68-31359# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
COST-EFFECTIVENESS COMPARISON OF TWO MULTICOUPLING APPROACHES TO HF TRANSMITTING SYSTEM ENGINEERING: INTEGRATED POWER AMPLIFIER COUPLER EQUIPMENT SHOWN TO BE MORE EFFECTIVE THAN CONVENTIONAL INSTALLATIONS OF SIMILAR COST
S. E. Parker 20 Feb. 1968 45 p refs
(WELC-1537; AD-670741)

Integrated power amplifier coupler approach is shown to provide increased communications effectiveness compared with conventional hf transmitter and multicoupling subsystems of equal cost. In particular, the PAC approach affords (1) increased circuit availability, (2) less interference, (3) better control of information bandwidth, (4) fewer problems from parasitic resonances, (5) simplicity of operation and (6) greater commonality. Author (TAB)

N68-31376# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.
STUDY OF THE CONTROL OF ELECTROMAGNETIC RADIATION FROM AIRCRAFT AND SPACE VEHICLES Final Report, 14 Aug. 1964–31 Dec. 1967
A. T. Villeneuve Mar. 1968 29 p refs
(Contract AF 19(628)-4349)
(P68-83; AFCRL-68-0208; AD-671147)

The research summarized in this final report constitutes the results of a three-year study of the control of the electromagnetic radiation from aircraft and space vehicles. The main objective of the program was the investigation of techniques that might find application in antennas for aerospace vehicles. Research was conducted in five major areas: waves in layered media, optimization of array gain, antenna pattern synthesis, phase-shifting techniques, and computational techniques for scanned arrays. These studies resulted in the publication of nine scientific reports which are summarized separately in this final report. Author (TAB)

N68-31406# Washington Univ., Seattle. Dept. of Electrical Engineering.
A DIRECTION INDICATION SYSTEM FOR A MULTIPLE ANTENNA ARRAY
John D. Winter, H. Myron Swarm, and Donald K. Reynolds Jan. 1968 59 p refs
(TR-112)

A multiple aperture antenna array is being constructed for use in antenna research, radio propagation studies, and radio astronomy. The accuracy of the direction indication system, which will consist of 30 or more parabolic reflectors and operate at approximately 915 MHz, depends on the accuracy of the initial calibration of the antenna array direction. Both the antenna direction comparison and the resulting slave antenna error indication indicate such a system to be superior to other techniques. While the direction indication system was designed to operate with a specific antenna array, more antennas can be added without modification to the existing circuitry. Position control, digital guidance, and electronic scanning systems are described for the radio telescope; and development of the error logic circuits and associated digital circuits is described. M.W.R.

N68-31417*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
ANALOG COMMUNICATIONS OVER SELECTIVE FADING CHANNELS Interim Technical Report
John C. Lindenlaub and Dennis P. Murray Jun. 1968 196 p refs
(Grant NsG-553)
(NASA-CR-95951; TE-EE68-12) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The performance of demodulators for analog communication over slowly time-varying, frequency selective fading channels was investigated. For known channels, demodulators optimal in the sense of maximum a-posteriori probability are derived for linear and angle modulation, but the resultant receiver structure for non-linear modulation is found to be impractical. Suboptimal approximations

to the optimal demodulator consisting of a transversal equalizer followed by post-equalization filtering of various kinds are compared to the optimal demodulator to determine whether these more easily implemented systems achieve near-optimal performance. For unknown channels, methods for channel measurement are considered which use either the information-bearing signal alone to probe the channel or a transmitted reference signal multiplied with the message. The effect of imperfect channel measurements on demodulator performance is investigated in an exact manner for the case of single-notch selective fading by means of a laborious numerical technique. Author

N68-31419*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TRACKING AND DATA ACQUISITION REPORT: MARINER MARS 1964 MISSION. VOLUME 2: CRUISE TO POST-ENCOUNTER PHASE
N. A. Renzetti 1 Oct. 1967 258 p refs
(Contract NAS7-100)
(NASA-CR-95989; JPL-TM-33-239, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The activities of the Deep Space Network (DSN) in support of the *Mariner* Mars 1964 Mission are summarized, covering the period from first spacecraft acquisition by the DSN to the end of the mission, October 1, 1965. The report delineates the following: the metric, telemetry, and command requirements placed on the network; the equipment configurations at the Deep Space Stations (DSS) of the Deep Space Instrumentation Facility (DSIF) needed to carry out the tracking and command functions; the Ground Communications System (GCS) configuration required to transmit data from the DSS to the Jet Propulsion Laboratory in Pasadena, California; and the equipment configuration in the Space Flight Operation Facility (SFOF) necessary for the reception, processing, and display of data to support the conduct of the spacecraft flight operations. An extensive table summarizes the DSN flight support afforded this mission; statistical data relating to time, operating DSS, received-signal level, and significant events appear in sequential entries. The DSN technical-operations support afforded to the various experiments and investigations, and to such tests as command lockup and encounter readiness, are described, along with special equipment used by the DSN in its operations. Finally, reliability summaries and performance evaluations of the DSN elements—the DSIF, the GCS, and the SFOF—permit conclusions as to the effectiveness of DSN operations over the entire period. Author

N68-31420*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ON THE APPLICATION OF EXTREME-VALUE STATISTICS TO COMMAND ORIENTED PROBLEMS
John C. Ashlock and Sandra M. Lurie 15 Oct. 1966 107 p refs
(Contract NAS7-100)
(NASA-CR-95988; JPL-TR-32-1025) CFSTI: HC $3.00/MF $0.65 $0.65 CSCL 17B

In commanding planetary spacecraft, system constraints allow data rates of only a few bits per second. Also, the accuracy of received information must be high since execution of an improperly received command could disrupt the mission. The problem of experimentally estimating or verifying error probabilities when the classical error-counting approach is too time consuming to use is considered. The rudiments of extreme-value theory are introduced for the univariate case where the bit-error probability of interest depends on a single variable, and for the bivariate case where the bit-error probability is a function of two dependent variables. Many examples are given, and numerical results are presented. Considerable attention is given to techniques of implementing the theory. Author

N68-31426*# Ohio State Univ., Columbus. ElectroScience Lab.
RADIATION PATTERN OF A GROUND-PLANE MOUNTED PARALLEL-PLATE WAVEGUIDE ANALYZED BY A SURFACE INTEGRATION TECHNIQUE
Edward Pelton, David Wu, and Roger Rudduck 25 Jul. 1968 35 p refs
(Grant NsG-448)
(NASA-CR-66672; REPT.-1691-28) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The radiation pattern of a TEM mode parallel-plate waveguide mounted in an infinite ground plane is analyzed by a surface integration technique. The fields on the surface of integration are obtained by use of wedge diffraction theory and include plane wave diffraction plus first order interactions at the guide aperture. A derivation of the surface integral formulation is presented. The radiation patterns obtained by surface integration for the ground plane mounted guide compare favorably with other approximate methods and provide an improvement in accuracy as compared to the wedge diffraction method. Direct application of the theory to certain other related antenna geometries is possible. Author

N68-31468# LTV Electrosystems, Inc., Greenville, Tex.
A TECHNIQUE FOR RESTORING SIGNAL DETAIL
E. O. Brigham Aug. 1968 10 p refs
(G3681.21.01D)

Transmission of a signal through a bandwidth-limited system results in distortion and loss of detail. The lost detail may be restored by inverse filtering. An analysis is made of the requirements of an optimum-design inverse filter, and a method of arriving at a convergent solution for this design is described. Two examples of the application of the technique are shown. One example shows the signal detail restoration achieved by inverse filtering of a signal which has been altered by passage through a low-pass filter; the other example illustrates the restoration of detail in a signal which has been smeared by a tape recorder head. Author

N68-31482# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunications Sciences and Aeronomy.
COMPUTER PROGRAMS FOR TROPOSPHERIC TRANSMISSION LOSS CALCULATIONS
Mary Ellen Johnson Sep. 1967 189 p refs
(IER-45-ITSA-45) GPO: $1.00

The computer programs to calculate tropospheric transmission loss and to estimate the performance of tropospheric point-to-point radio systems for within-the-horizon, knife-edge diffraction, and tropospheric scatter paths are presented. Discussions of the programs and detailed descriptions of the input and output formats are included. Author

N68-31612*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
AROD SYSTEM CONCEPT AND APPLICATIONS STUDIES Final Report
15 Dec. 1967 92 p refs
(Contract NAS8-11835)
(NASA-CR-61904; MAF3065-8-9) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Analyses and observations are reported for the Airborne Range and Orbit Determination (AROD) concept, its implementation, and its potential extension and applications. Extension of range capability is discussed; and attention is given to both the utilization and elimination of the very high frequency link as well as to the inverted mode operation and the S-band data channel capacity for this launch or space vehicle-based continuous wave radio frequency system. Atmospheric and ionospheric propagation corrections were made, and the Geometrical Dilution of Precision (GDOP) was considered in terms of ground stations, redundancy, and two-dimensional analysis. Applications discussed for AROD include tactical and geodetic surveying, navigation satellite systems, range instrumentation, and oceanography. The system requirements and a model for Long Range Position Determining System (LRPDS) are discussed, and similarities between AROD and LRPDS are examined. M.W.R.

N68-31567# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MULTICHANNEL RECEPTION OF SIGNALS, NONLINEARLY DEPENDING UPON RANDOM PARAMETERS [MNOGOKANAL'NYY PRIYEM SIGNALOV, NELINEYNO ZAVISYASHCHIKH OT SLUCHAYNYKH PARAMETROV]
L. P. Sysoyev 27 Sep. 1967 14 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Avtomatiki i Telemekh., Tekhn. Kibernetika (Moscow), 1965 p 47–55
(FTD-HT-23-518-67; AD-670817)

The author investigates problems in the evaluation of parameters and the detection of signals which depend nonlinearly on random parameters. The case studies are when these signals are received by the various inputs of a receiving system against a background of noise. If the noises at the various inputs are not related to a determined dependence, and the useful signals have certain common parameters, then a greater accuracy may be expected in the evaluation of these parameters than with the employment of only one signal. TAB

N68-31599# Joint Publications Research Service, Washington, D. C.
SHIELDING RADAR FROM NON-SYNCHRONOUS PULSE NOISE
A. G. Luzan 22 Jul. 1968 8 p Transl. into ENGLISH from Vestn. Protivovozdushnoy Oborony (USSR), no. 5, 1968 p 61–64
(JPRS-45950)

Memory tubes that separate nonsynchronous noise pulses from radar signals are considered; and the use of these tubes in nonsynchronous noise filters (FNP) with barrier grids is considered practical from a reliability point of view. Even though the memory tubes with barrier grids have a high level of internal noise arising from the modulation of the continuous beam by the deflection field, a high frequency modulation voltage from a special generator can be applied to the memory tube modulator to permit the desired frequency separation. Schematics of an FNP with subtractive stages and of a gated FNP are included, and a schematic of voltages at basic junctions of an FNP built according to the former is shown. M.W.R.

N68-31606 Joint Publications Research Service, Washington, D. C.
ANTENNA PATTERN ERRORS IN PRESENCE OF AERODYNAMIC RADOME HEATING
Ye. A. Vorob'yev 25 Jul. 1968 3 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radioelektron. (USSR), v. 10, no. 2, Feb. 1967 p 197–198
(JPRS-45981)

Determination of error in position of an antenna beam during aerodynamic heating of a radome is illustrated, as is the dependence curve during aerodynamic heating for the value of the angular error in the antenna beam position as a function of the antenna folding angle. In the case of supersonic speeds, the angular error in the position of the radar antenna beam can be inadmissibly high. The radome contour is described by assuming that the center of a rectangular system of coordinates coincides with the center of the antenna rotation. M.W.R.

N68-31613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTENNAS WITH NON-MECHANICAL BEAM MOVEMENT (INTRODUCTION TO THEORY)
O. G. Vendik 21 Dec. 1967 345 p refs Transl. into ENGLISH from "Antenny S Nemekhanicheskim Dvizheniyem Lucha (Vvedeniye V Teoriyu)" Moscow, Izd. Sovetskoye Radio, 1965 p 1–360
(FTD-HT-23-513-67; AD-670785)

The book is devoted to studying the properties of systems of radiators intended for non-mechanical beam steering. It covers questions of the first set related to the antenna system and barely touches on questions pertaining to signal processing systems. The principles of operation and the procedures for the design of phase shifters, commutators, electronic control circuitry for these or electronic circuitry for direct processing of the signal is mentioned only with reference to the basic parameters of certain of them and the general characteristics of the steering system. TAB

N68-31614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TELEMETRY EQUIPMENT WITH DIGITAL READING
I. I. Mikhaylov 7 Sep. 1967 111 p refs Transl. into ENGLISH of "Apparatura Teleizmereniya S Tsifrovym Otschetom" Kiev, Izd. Tekhn., 1964 p 1–123
(FTD-MT-66-68; AD-670943)

Contents: Basic peculiarities of telemetry equipment with digital reading; Elements of pulse technology applied in telemetry equipment with digital reading; Digital reading systems; Telemetry systems with digital reading. Author (TAB)

N68-31616# Air Force Systems Command, Wright-Patterson AFB, Ohio. ForeignTechnology Div.
A METHOD OF CORRECTING AMPLITUDE SIGNALS IN MULTICHANNEL TELEMETRY [METOD KORREKTSII AMPLITUDNYKH SIGNALOV V MNOGOKANAL'NOY TELEMETRII]
S. V. Alekseyev 25 Oct. 1967 9 p refs Transl. into ENGLISH from Tr. Energ. Inst. (Moscow), no. 52, 1963 p 193–197
(FTD-HT-67-379; AD-670905)

The use of amplitude modulation in telemetry is limited by large errors due to communication-channel variations and low noise immunity. To improve the system, the following method of correcting signal is suggested. In addition to several harmonic components of the frequencies modulated by desirable signals, an a-c voltage of a stable amplitude and frequency f is also transmitted over the same channel. Individual harmonic components are isolated by band-pass filters and detected in the receiver. Corrections are introduced into the gain of the information-carrying frequency-isolating filters in accordance with the attenuation of the correcting-signal amplitude. Due to the fact that the attenuation depends on the carrier frequency, the correction factor must be determined from a suitable function. Allowance for noise is also necessary. Author (TAB)

N68-31624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CODE-PULSE DECODER WITH CORRECTION OF ERRORS [KODO-IMPUL'SNYY DESHIFRATOR S KORREKTSIYEY OSHIBOK]
A. N. Svenson and N. T. Tynnaya 19 Oct. 1967 9 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Elementy Sistem Otbora i Peredachi Inform. (Kiev), 1965 p 14–19
(FTD-HT-23-515-67; AD-670911)

In the case of error correcting codes, the decoder must work out not only the particular code word but also those words differing from the given one by one, two, or more letters. Since the pyramidal or matrix decoders require usually a large number of elements, the authors outline the feasibility of the construction of code-pulse error correcting decoders for codes transmitted by sequential or parallel pulses. They analyze the possible solution for such decoders for a varying number of correcting errors and discuss their operation as a function of the parameters of the circuitry. One of the solutions can decode both parallel and sequential signals. Another is constructed from standard cells. Author (TAB)

N68-31639*# National Aeronautics and Space Administration, Electronics Research Center, Cambridge, Mass.
RESEARCH ON FIELD-ALIGNED PROPAGATION OF HF RADIOWAVES USING ALOUETTE 2 TOPSIDE SOUNDER DATA AND DIGITAL RAY-TRACING TECHNIQUES

Jayaram Ramasastry, Edward J. Walsh, and John R. Herman (Lowell Technol. Inst. Res. Found.) Washington Aug. 1968 34 p refs Presented at the AGARD meeting, Oslo, 19–23 Aug. 1968
(NASA-TN-D-4748) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The first part of this technical note covers the study of guidance of HF radiowaves along field-aligned paths using the topside sounder data from the Alouette 2 satellite. More than 100,000 Alouette 2 ionograms have been used in this analysis and an unusually high percentage of occurrence of conjugate echoes has been observed in the data of some equatorial stations. Two interesting types of ionograms containing conjugate echo traces are presented. A self-consistent explanation based on the assumption of multiple reflections between conjugate points of the field line passing through the satellite is presented. The second part of the note covers the results of the digital ray tracing study of the guidance of HF radiowaves along field-aligned ionization irregularities in the magnetosphere of the earth. The results reported here on the HF ducting phenomenon is directed primarily towards determining whether such a mechanism may be utilized to study the magnetospheric phenomena and whether it can be useful as a reliable communication link. Author

N68-31641# Weapons Research Establishment, Salisbury (Australia).
A STUDY OF A RECURSIVE DIGITAL FILTER FOR ESTIMATING VELOCITY FROM FPS 16 RADAR INFORMATION
J. L. Roughan Jun. 1967 39 p refs
(WRE-TN-ISD-81) CFSTI: HC $3.00/MF $0.65

The particular filter studied in this note, is a quadratic velocity estimator. This filter is extended to enable velocity estimation at any future or past time. The characteristics of the filter have been examined with regard to frequency response, ratio of noise on input to noise on velocity output for both white noise and colored noise, velocity lag following an acceleration step, and lag to a cubic input. The characteristics of a particular version of this filter are compared with those of the equivalent moving arc filter. From computer experiments with various parameters of the recursive filter an indication is obtained that the end-point version of the filter for real time impact prediction is satisfactory. Results from an experimental study of the effect of dynamically changing the cut off frequency of the filter are given. Author

N68-31692# Environmental Science Services Administration, Boulder, Colo. Research Labs.
AN INEXPENSIVE DIGITAL DATA ACQUISITION SYSTEM
H. L. Steadman Jan. 1968 16 p
(RLTM-ITS-113; PB-177732) CFSTI: HC $3.00/MF $0.65

The report describes a highly flexible digital data acquisitions system that can be duplicated for $8,000. The system is for VLF research, but it could be easily adapted to a wide variety of problems. It is capable of sampling up to 16 channels of 2 signals each, digitizing each signal in a 10-bit code and punching the output on paper tape, showing time and other identification at a rate of up to 100 channels/second. The system is easily expandable in a number of ways to provide increased capabilities. Author (USGRDR)

N68-31697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOW TO ELIMINATE CROSS-MODULATION CROSS TALK
Lin Hua 6 Nov. 1967 8 p Transl. into ENGLISH from Wu Hsien Tien (Communist China), no. 10, 1965 p 22–23
(FTD-HT-67-388; AD-670906)

Cross-modulation coupling is caused by the nonlinearity of the converter. The carrier of the principal signal is amplitude modulated by the interference signal and is received together with the principal signal. To eliminate this undesirable effect, the ability of the input circuit to suppress the interference signal must be increased. One way to achieve this would be to use a directional rotary antenna, although a magnetic antenna would be best for this purpose. By using the capacitive coupling of the antenna to the input circuit, the Q value (hence, selectivity) of the antenna circuit can be made larger than by using inductive coupling. A loose coupling between the antenna and the tuning circuit will decrease the sensitivity somewhat, but will increase the overall selectivity. The selection of the working point for the remote cut-off tubes 6U1, 6K4, and 6K3P is important for the elimination of envelope distortion. The output of the local oscillator should be adjusted for optimum performance. Author (TAB)

N68-31724# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
AN EXPLORATORY TEST OF DATA TRANSFER BY VHF TO AIRCRAFT OVER THE OCEAN IN A TROPOSPHERIC PROPAGATION ENVIRONMENT Interim Report
Joseph J. Scavullo Jun. 1968 102 p refs
(NA-68-10; RD-68-27; AD-671057)

Two very high frequency (VHF) troposcatter antennas, each with 16 colinear dipoles in a vertical array, were installed about 80 wavelengths apart at a site near the coast at Avalon, New Jersey. These antennas had flat, broad, high-gain radiation patterns directed in parallel toward the horizon. Exploratory tests were conducted while transmitting test signals, in a controlled sequence, between the site and a project aircraft operating over the ocean. In the sequence of test signals, a period of no modulation was followed by a calibrated audio tone, teletype messages and voice messages. Each sequence was repeated so that performance during phase modulation of the VHF transmitter could be compared with performance during amplitude modulation. The test site, test experience, and data are described as guidance for further experimentation in the same environment. The test indicated that simple substitution of low-speed data modulation for voice modulation, or of phase modulation for amplitude modulation, would not produce a substantial change of performance in a system designed for voice communications. The report recommends a test to determine probable operational coverage of these troposcatter antennas. Author (TAB)

N68-31730*# Stanford Research Inst., Menlo Park, Calif.
OPTICAL COMMUNICATION AND TRACKING SYSTEMS Final Report, 1 Oct. 1966–30 Sep. 1967
Robert M. Dressler and Edward C. Fraser Oct. 1967 103 p refs
(Contract NAS12-59; SRI Proj. 5578)
(NASA-CR-86090) CFSTI: HC $3.00/MF $0.65 CSCL 17H

The research program has investigated the control and tracking problems associated with an optical communication system operating between the earth and a spacecraft in the vicinity of Mars. For the system configuration studied, mathematical models of all system components are developed including the relative motion of the two communication terminals, the dynamics of the earth terminal receiving telescope, the optical propagation properties of the atmosphere and free space, and a statistical description of the optical and mechanical measuring devices used to obtain control or output data from the system. Two design approaches to this problem are taken. The first, which is based on results from optimal linear estimation and control theory, results in the estimator-controller configuration. The second design employs classical servo theory and yields the autotracker system. The optical communication and tracking system, employing either the estimator-controller or the autotracker, was simulated by means of a digital computer. It can be concluded that it is within the capability of present technology to implement a deep space optical communication system that will provide a significant increase in data rate over present techniques. Author

N68-31759*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROCEEDINGS OF THE SPACE OPTICAL TECHNOLOGY CONFERENCE, VOLUME 1
Apr. 1966 156 p refs Conf. held 2–4 Nov. 1965
(NASA-TM-X-61037) CFSTI: HC $3.00/MF $0.65 CSCL 09F

CONTENTS:

1. PARTICIPATION OF AMES RESEARCH CENTER IN THE MSC-4 EXPERIMENT N. S. Johnson (NASA. Ames Res. Center) p 1–7 (See N68-31760 19-16)

2. RADOT, 60.96-CM(24-IN.) MULTIMODE TELESCOPE AND FUTURE FACILITIES W. J. Carrion (NASA. Goddard Space Flight Center) p 9–15 (See N68-31761 19-07)

3. ANALYSIS OF A TEN-MICRON COMMUNICATION SYSTEM N. Mc Avoy (NASA. Goddard Space Flight Center) p 17–31 refs (See N68-31762 19-07)

4. SPHERICAL MIROS P. O. Minott (NASA. Goddard Space Flight Center) p 33–41 (See N68-31763 19-07)

5. THE OPTICAL IMAGING SYSTEMS FOR RANGER, MARINER, AND SURVEYOR TELEVISION E. P. Martz, Jr. (JPL) p 43–50 (See N68-31764 19-14)

6. ADVANCED COMPUTER DESIGN TECHNIQUES FOR OPTICAL SYSTEMS J. M. Mc Lauchlan (JPL) p 51–57 (See N68-31765 19-08)

7. FEASIBILITY STUDIES OF OPTICAL SPACE COMMUNICATIONS AND TRACKING, AND OTHER ACTIVITIES OF THE JPL QUANTUM ELECTRONICS GROUP W. H. Wells (JPL) p 59–65 refs (See N68-31766 19-07)

8. TECHNOLOGY FOR A MANNED ORBITING TELESCOPE W. E. Howell (NASA. Langley Res. Center) p 67–80 (See N68-31767 19-14)

9. OPTICAL COMMUNICATIONS EXPERIMENTS ON GEMINI VII D. S. Lilly (NASA. Manned Spacecraft Center) p 81–90 (See N68-31768 19-07)

10. MANNED SPACECRAFT CENTER LASER PROGRAMS AND PLANS W. L. Thompson (NASA. Manned Spacecraft Center) p 91–97 (See N68-31769 19-16)

11. WHITE SANDS MISSILE RANGE STATION FOR MSC-4 R. W. Ward (NASA. Manned Spacecraft Center) p 99–102 (See N68-31770 19-07)

12. THE OPTICAL GUIDANCE SYSTEM FOR RENDEZVOUS C. L. Wyman p 103–114 refs (See N68-31771 19-21)

13. OPTICAL TECHNOLOGY EXPERIMENTS FOR APOLLO APPLICATIONS PROGRAM E. J. Reinbolt and J. L. Randall p 115–129 (See N68-31772 19-07)

14. SOME ASTROPHYSICAL INSTRUMENTATION CONSIDERATIONS RELATED TO SPACE OPTICAL TECHNOLOGY G. A. Vacca (NASA. Headquarters) p 131–142 (See N68-31773 19-14)

N68-31761*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADOT, 60.96-CM (24-IN.) MULTIMODE TELESCOPE AND FUTURE FACILITIES
Walter J. Carrion *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 9–15 (See N68-31759 19-07)

Future requirements for precision optical tracking instrumentation are stated, and two tracking systems are briefly described. The first is a Nike-Ajax system for a laser tracking experiment, modified by adding shaft angle encoders, water cooled laser, telescope receiver, programmer, and the guiding scopes. This system is tracking the S-66 satellite, receiving up to 92% return of the transmitted pulses during a single pass. The second system is the Real-time Automatic Digital Optical Tracker (RADOT), which is a precision computer controlled optical tracker. The x-y mount of this tracker operates with an accuracy of two seconds of arc. The need for an optical research facility equipped with a large aperture telescope and associated instrumentation designed for communication experiments in conjunction with interplanetary missions and planetary studies is pointed out. K.W.

N68-31762*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF A TEN-MICRON COMMUNICATION SYSTEM
Nelson McAvoy *In its* Proc. of the Space Opt. Tech. Conf., vol. 1 Apr. 1966 p 17–31 refs (See N68-31759 19-07)

This analysis and the resulting proposed communication system is based on presently available equipment or equipment that can be readily modified. An experiment is outlined which, in conjunction with those under study for the optical technology satellite, can result in sufficient know-how to design a communications transmitter and auxiliary equipment for a Mars probe that will transmit a real-time TV signal to earth. In this study, the capabilities of receivers are established by defining theoretically the signal and noise relations in optical detectors. The reasons for choosing the ten-micron range over the visual range for optical communication experiments are given as: (1) better lasers; (2) large coherence areas; (3) coherence areas compatible with diffraction limit of scopes; (4) diffraction limit of scopes compatible with their tracking accuracy; (5) no need for high quality (accuracy) optics; (6) best atmospheric window; (7) smaller Doppler shifts; and (8) less power per information bit required at the receiver. Realistic parameters are listed for transmitters and receivers in telemetry links between a Mars-probe-borne laser and earth. The experimental verification of such a telemetry link with the Echo 2 satellite is proposed. K.W.

N68-31763*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPHERICAL MIROS
P. O. Minott *In its* Proc. of the Space Opt. Tech. Conf., vol. 1 Apr. 1966 p 33–41 (See N68-31759 19-07)

Spherical MIROS (Modulation Inducing Retrodirective Optical System) as described in this paper is an outgrowth of the original MIROS concept and is intended as a means of laser communication relay via satellite. An optical analog to the Echo satellites, the Spherical MIROS relays between two ground stations via reflection of electromagnetic radiation from a passive satellite. The system does not require a laser transmitter at each end of the communication link. Because of its simple construction and retrodirective properties, it would have an extremely long lifetime and would not require accurate stabilization of the satellite. Its passive nature requires only minimal power supplies, thereby reducing weight and cost. In addition to a description of the system, the equation for energy received by the ground receiver is discussed to illustrate its capabilities. Some possible applications of the system are listed. K.W.

N68-31766*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FEASIBILITY STUDIES OF OPTICAL SPACE COMMUNICATIONS AND TRACKING, AND OTHER ACTIVITIES OF THE JPL QUANTUM ELECTRONICS GROUP
Willard H. Wells *In* NASA. Marshall Space Flight Center Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 59–65 refs (See N68-31759 19-07)
(Contract NAS7-100)

Discussed are problems in connection with feasibility studies of a N_2-CO_2 laser at 10.6 μ for optical communication and tracking, including economic considerations that led to the choice of this wavelength. Reliability, weather dependence, and pointing accuracy of optical frequency communication systems are evaluated against the role of radio frequency communication telemetry. A table of decibels is presented and discussed which compares the possibilities of the following five wavelengths: (1) the 13 cm S band as used with the 64-m D antenna at the Deep Space Instrumentation Facility at Goldstone; (2) the 10.6 μ, generated by an efficient gas laser; (3) the 3.5 μ, included for possible future developments; (4) the 0.84 μ, generated by a compact, efficient GaAs injection laser; and (5) the 0.63 μ, generated by a helium-neon laser. K.W.

N68-31768*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OPTICAL COMMUNICATIONS EXPERIMENTS ON GEMINI 7
D. S. Lilly *In its* Proc. of the Space Opt. Tech. Conf., vol. 1 Apr. 1968 p 81–90 (See N68-31759 19-07)

Procedures, ground equipment, and equipment aboard the spacecraft for the inflight testing of the MSC-4 optical communication experiment are described. The experiment is a study in a pulse-frequency-modulation optical communications link and makes available a coherent optical radiator outside of the earth's atmosphere. Atmospheric data such as transmission properties, background levels, scintillation, scattering, and index-of-refraction variations are recorded. Results of preliminary sky background and signal level measurements at White Sands, N.M., are also given. K.W.

N68-31770*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
WHITE SANDS MISSILE RANGE STATION FOR MSC-4
R. W. Ward *In its* Proc. of the Space Opt. Tech. Conf., vol. 1 Apr. 1968 p 99–102 (See N68-31759 19-07)

The MSC-4 optical communication experiment on Gemini 7 involves laser transmission and the reception of data which will be used to verify existing models of the atmosphere and to develop a more detailed modal. This paper briefly covers the types of data to be collected at the White Sands receiving site and the interpretation of the data in relation to the statistical properties of the atmosphere. Variance, the autocorrelation function, and the signal correlation equipment are identified. K.W.

N68-31772*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTICAL TECHNOLOGY EXPERIMENTS FOR APOLLO APPLICATIONS PROGRAM
E. J. Reinbolt and J. L. Randall *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1968 p 115–129 (See N68-31759 19-07)

Concepts and techniques of the optical technology experiments are outlined. Some of the requirements of deep-space communication systems and of space-borne astronomical telescopes are examined, including diffraction-limited performance of large apertures, fractional arc-second guidance, isolation from vehicular disturbances, and ground controlled testing and adjustment. Experiments are proposed for studying specific problems of optical technology, for the theoretical and experimental examination of several aspects of tracking and point-ahead, optical heterodyne detection, atmospheric effects, and background radiation. A special effort is made to point out the close interrelationship existing between most of these experiments. K.W.

N68-31774# Auburn Univ., Ala. Antenna Study Group.
STUDY OF CIRCULAR ARRAYS OF RADIAL AND TANGENTIAL DIPOLES Final Report, 1 Mar. 1965–28 Feb. 1968
C. H. Holmes and J. L. Hilburn 28 Feb. 1968 36 p refs
(Contract AF 19(628)-4991)
(AFCRL-68-0187; AD-670883)

The circular arrays investigated consist of N identical center-fed cylindrical dipoles which lie in the plane of a circle and whose centers are equally spaced around the circumference of the circle. In the case designated tangential arrays the elements are placed tangential to the circle and in the case designated radial arrays they are placed radial to the circle. This study first presents the derivation of the integral equations defining the vector potential over the surfaces of the elements. These equations are reduced to a single integral equation by using sequence terminal voltages. The Gaussian quadrature formula for numerical integration is used to solve the equation for each sequence. Methods of obtaining the sequence terminal admittances are also described. Experimental results are compared with theory for a driven monopole in a tangential array positioned on a ground-plane. Radiation patterns determined from the numerical currents are compared with those obtained from assumed sinusoidal currents. Author (TAB)

N68-31824# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
STUDY OF SONAR ARRAY PROCESSING TECHNIQUES Final Report, 1 Jan. 1967–31 Mar. 1968
Harry L. Van Trees and Arthur B. Baggeroer 31 Mar. 1968 21 p
(Contract N00140-67-C-0210)
(AD-670557)

The report is concerned with the use of state-variable techniques for solving Fredholm integral equations, and the application of the resulting theory to several communication problems. It discusses the following areas: the solution of homogeneous and nonhomogeneous Fredholm integral equations; optimal signal design for additive colored noise channels; optimal smoothing and filtering with delay; smoothing and filtering for nonlinear modulation systems; and estimation in a distributed environment. Author (TAB)

N68-31883# Advanced Technology Corp., Timonium, Md.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FOCAL PLANE ADAPTIVE ANTENNA TECHNIQUES Final Report, 1 Apr. 1967–31 Mar. 1968
Marvin Cohn and Robert S. Littlepage Apr. 1968 81 p refs
(Contract F19628-67-C-0299)
(AFCRL-68-0249; AD-670830)

A scalar analysis was performed to determine the field structure in the focal region of apertures focused in their near field ($f/D<1$). Solutions are given for plane waves at normal incidence, and several selected angles of arrival. The results indicate a substantial variation from the Fraunhofer far field patterns. Because it is a scalar approach, it is limited to large apertures ($D>>$ wavelength) and small diffraction angles. An experiment was designed to complement the analysis. The qualitative agreement is very good. Sources of experimental error have been found which account for the quantitative variations. A technique for determining the field structure in the focal region, due to a reasonably arbitrary distribution in the aperture plane, is given. It consists of the superposition of an ensemble of plane waves, whose amplitude, relative phase, and angle of arrival are determined by the aperture plane distribution. Author (TAB)

N68-31920# Texas Instruments, Inc., Dallas.
DEVELOPMENT OF INTEGRATED MICROWAVE COMPONENTS FOR GROUND BASED PHASED ARRAYS Final Technical Documentary Report, 17 Apr. 1967–15 Jan. 1968
Jim Austin and Lafe R. Pfieffer, Jr. Jan. 1968 36 p refs
Prepared for Lincoln Lab., MIT, Lexington
(Contract AF 19(628)-5167; ARPA ORDER 498)
(TI-03-63-03; ESD-TR-68-53; AD-668763

The overall goal of this program was to design an element steering module that would be easily produced in large quantities at a minimum cost. The effort of this program was directed toward the design of the ESM in a microstrip form utilizing thin-film techniques to form the resistors, capacitors and transmission-time elements on a ceramic substrate. Author (TAB)

N68-31995*# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
PHASED ARRAYS FOR METEOROLOGICAL SATELLITE
Charles E. Profera, Jr. Cambridge, Mass. NASA. Electron. Res. Center Jun. 1968 58 p refs
(Contract NAS12-149)
(NASA-CR-86089) CFSTI: HC$3.00/MF$0.65 CSCL 09F

An H-plane sectoral horn-lens line source was developed for use in a Ku-band phased array. A prototype ten-element array of these line source elements was constructed and tested. Inter-element spacing is consistent with a maximum scan requirement of ±60°. Element patterns recorded over the 15.2 to 16.8 GHz frequency band exhibit extremely low sidelobes with no maximum sidelobes exceeding −32 dB. Line source patterns and relative gain measurements give no indication of undesirable effects due to element location within the array. Multi-mode techniques were employed in the design of a fifty-way power combiner for use with an array of fifty line source elements. Combiner radiation patterns agree very well with those of the E-plane sectoral multi-mode horn-lens antenna which is an integral part of the combiner. Maximum sidelobe levels of approximately −30 dB are obtained at 16.0 GHz. Sidelobe performance deteriorates toward the 15.2 to 16.8 GHz frequency band edges. A study was also conducted to determine the phase shifter requirements and problems inherent in electronically scanning the array beam to ±60°. Author

N68-32115# European Space Technology Center, Delft (Netherlands).
FREQUENCY-DIVISION MULTIPLEXING/FREQUENCY MODULATION (FM/FM) TELEMETRY
J. Toussaint *In* ESRO Spacecraft Technol. Vol. 3 Nov. 1966 24 p *Its* Conf. No. 25 (See N68-32113 19-14)

General characteristics of frequency modulation are recalled and principles of FM/FM telemetry systems laid down. Advantages and disadvantages of the system are discussed and compared with those of FM and PM transmitters. Performances of a FM/FM telemetry chain are evaluated. ESRO

N68-32116# European Space Technology Center, Delft (Netherlands).
PULSE CODE MODULATION TELEMETRY
J. Toussaint *In* ESRO Spacecraft Technol. Vol. 3 Nov. 1966 24 p *Its* Conf. No. 26 (See N68-32113 19-14)

Basic principles of PCM are recalled. The block diagram and operating mode of a PCM telemetry system are presented and discussed and its performances evaluated. Envisaged application to the ESRO I system is indicated. ESRO

N68-32117# European Space Technology Center, Delft (Netherlands).
PULSE FREQUENCY MODULATION TELEMETRY
J. Toussaint *In* ESRO Spacecraft Technol. Vol. 3: Nov. 1966 14 p *Its* Conf. No. 27 (See N68-32113 19-14)

Basic principles of PFM are recalled. The block diagram and operating mode of PFM telemetry systems are presented and discussed, and its performances and limitations evaluated. ESRO

N68-32118# European Space Technology Center, Delft (Netherlands).
SATELLITE LOCALIZATION SYSTEMS [SYSTEMES DE LOCALISATION DES SATELLITES]
J. Le Peltier *In* ESRO Spacecraft Technol. Vol. 3: Nov. 1966 42 p In FRENCH *Its* Conf. No. 29 (See N68-32113 19-14)

Kepler laws and definition of orbit parameters are recalled. Atmospheric diffraction limiting the accuracy of distance and direction measurement is presented. Radar, interferometric and doppler effect measurements are discussed. Advantages and disadvantages of each method are given. ESRO

N68-32169 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
STATISTICAL ANALYSIS OF THE METHOD OF PAIR-SELECTION IN CONTENT ADDRESSABLE SYSTEMS
Jozef Kosacki (Ph.D. Thesis) 1968 70 p refs
(IBJ-900131E) CFSTI: $3.00

Content addressable systems are considered to offer better use of memory space than the conventional multiparameter analyzer, even though the number of channels in the content addressable system is not always sufficient. Statistical analysis is, therefore, made of the method of path selection in such addressable systems based on a sliding pair selection theory. Theory of discrete and continuous distribution of information by this method is given, and a comparison is made of the filling time of a store-sample for pair selection with a first come, first arrived selection. Practical applications of pair selection are discussed. Author

N68-32183*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-51, VOLUME 2 FOR THE PERIOD MARCH 1 TO APRIL 30, 1968. THE DEEP SPACE NETWORK
31 May 1968 178 p refs
(Contract NAS7-100)
(NASA-CR-96159; JPL-SPS-37-51, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Summarized are research and technical activities in support of the Deep Space Network (DSN) which is responsible for two-way communications with unmanned spacecraft traveling approximately 10,000 mi from earth to interplanetary distances. Studies in the following areas are examined: mission support; advanced engineering; development and implementation; and operations and facilities. S.C.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-31017# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIGITAL CORRELATOR DK-2 [DISKRETNYI KORRELYATOR DK-2]
N. S. Chakhirov and A. N. Basiteshvili 5 Oct. 1967 18 p refs Transl. into ENGLISH from Tr. Akad. Nauk Gruzin. SSR Inst. Elektron., Avtomatiki i Telemekhaniki (Tiflis), v. 5, 1964 p 133–141
(FTD-MT-24-290-67; AD-671141)

The operation and the construction of the various units of the correlator are described in detail. It is expected that a single point of a correlation function consisting of 500 ordinates will be calculated by the DK-2 in 10 seconds, as against a minute in the earlier model. It is pointed out in the conclusion that although the final construction design of the DK-2 is incomplete, the final dimensions of the unit are expected to be smaller than the earlier model. TAB

N68-31195# Radio Corp. of America, Princeton, N. J. RCA Labs.
A REPRESENTATION SYSTEM FOR PARSING PROCEDURES
Daniel A. Walters (Ph.D. Thesis—Pennsylvania Univ.) [1968] 326 p refs
(Contract F44620-68-C-0012)
(AFOSR-68-1301; SR-1; AD-670577)

The report describes a system for representing a class of parsing procedures for context-free phrase-structure languages. The system, called RS, is based on the reduction systems of problem solving used in such areas as machine theorem proving. The report discusses in great detail the requirements for obtaining an accurate and detailed dynamic description in RS of a given parsing procedure, and defines a model of a procedure to be a representation

in RS satisfying these requirements. Models are presented for a large number of existing parsing procedures, and these models are used to display similarities and discrepancies among the procedures. An extension of RS is presented that allows the development of new and much more flexible parsing procedures. This extension utilizes the property of reduction systems that the solution methods used for different problems can be chosen independently of each other. A procedure is presented in this extended system which has available to it both extensions of the models previously developed and efficient processors for deterministic sub-grammars of a given grammar. This procedure is proved to be a solution algorithm for any derivation problem, regardless of which solution techniques are used. The report discusses the suitability of RS as a research tool, a specification language, and a tutorial vehicle, and how it can be used for these purposes. Author (TAB)

N68-31299# Stanford Univ., Calif. Dept. of Computer Science.
A MULTI-LEVEL COMPUTER ORGANIZATION DESIGNED TO SEPARATE DATA-ACCESSING FROM THE COMPUTATION
Victor R. Lesser 11 Mar. 1968 23 p refs Supported in part by NSF
(SU-CS-90; PB-178177) CFSTI: HC$3.00/MF$0.65

The computer organization to be described in this paper has been developed to overcome the inflexibility of computers designed around a few fixed data structures, and only binary operations. This has been accomplished by separating the data-accessing procedures from the computational algorithm. By this separation, a new and different language may be used to express data-accessing procedures. The new language has been designed to allow the programmer to define the procedures for generating the names of the operands for each computation, and locating the value of an operand given its name. Author (USGRDR)

N68-31300# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASIC CONSTRUCTION PRINCIPLES OF THE RER-2 ANALOG-DIGITAL COMPUTER [OSNOVNYE PRINTSIPY POSTROENIYA ANALOG-TSIFROVOI VYCHISLITELNOI MASHINY RER-2]
S. A. Ginzburg Jun. 1967 20 p refs Transl. into ENGLISH from Tr. Vses. Nauchn. Issled. Inst. Elektroenergetiki (USSR), no. 18, 1964 p 88–98
(FTD-MT-66-161; AD-671145)

In 1962 the first RER analog-digital computer was manufactured and put into operation with the purpose of computing the economic conditions of the united energy system of the European USSR. All the operations of this machine were performed in analog form and parallel in time, which resulted in large quantities of equipment and reduction of reliability. During the construction of a machine for the energy system of Siberia the principle of series operation of elements was used to improve the reliability. In this type of machine, RER-2, for a repeatedly using the same analog element there were introduced memory elements and key circuits for switching. By using the principle of series operation the quantity of equipment decreases naturally but at the same time the time for the solution of the problem increases. To keep order in the performance of computing operations it is necessary to use a program determining this sequence. The program is a sequence of switching keys and it corresponds to the problem which is being solved by the machine. The program and the method for the solution of the problem are described. The characteristics of the machine RER-2 are given and its structural diagram is described. Author (TAB)

N68-31301# Pennsylvania State Univ., University Park. Ordnance Research Lab.
SIMULTANEOUS ANALYSIS OF NONLINEAR NETWORKS ON A DIGITAL COMPUTER
P. A. Honkanen 1 Nov. 1967 192 p refs
(Contract Now-65-0123-d)
(TM-643.3471-04; AD-670729)

The purpose of this investigation was to develop the necessary techniques and algorithms to allow the solution of a general nonlinear network on a large scale digital computer. The network equations describing a general nonlinear network were developed from basic principles to obtain a final formulation that describes the network as a set of nonlinear differential equations. Since these equations must be solved numerically, a method that gives the minimum set of equations was chosen. This formulation is the state variable form with the capacitive voltages and inductive currents chosen as the variables. The existence and uniqueness of the analytical solution was shown to exist if the partial derivatives of the parametric network functions are continuous functions. Computer algorithms were developed to accept the schematic network representation and the nonlinear parameter functions, and generated all the required topological and parametric relationships. The numerical experiments conducted during the course of this investigation verify the accuracy of simulation and the versatility of the methods developed in analyzing general nonlinear networks. Author (TAB)

N68-31309# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF REPAIRING AND TROUBLE-SHOOTING ELECTRONIC DIGITAL COMPUTERS [METOD NALADKI ETSVM NAKHOZHDENIYA V NIKH NEISLRAVNOSTEY]
A. I. Dobrolyubov and V. S. Mikhaylov 14 Jul. 1967 17 p ref Transl. into ENGLISH from Mekhaniz. i Avtomatiz. Proizv. (USSR), no. 1, 1966 p 48–51
(FTD-HT-23-756-67; AD-671132)

In connection with the fact that only highly qualified repairmen or operators can more or less quickly find trouble in electronic digital computers and thus reduce the downtimes of the machine, the so-called functional cyclograms are proving to be of great help for the rapid finding of trouble and also for teaching servicing personnel. Functional cyclograms of electrical circuits of the computer units yield in a graphic and concise form sufficiently complete information on the work of a given circuit, functions, and interactions of its elements and are a convenient means of analyzing circuits and are needed when estimating the reliability of circuit operation. The development of functional cyclograms for complex fundamental electrical circuits of the computer units is a rather laborious process, but once it has been compiled the cyclogram makes it possible for unskilled servicing personnel to rapidly analyze a complex circuit. In this article, the authors prescribe the method of functional cyclograms for the specific example of a simplified circuit of a magnetic tape marking unit of the Minsk-2 electronic digital computer. It is shown that in this case the functional cyclogram appreciably facilitates analysis of the work of the computer circuits and finding troubles in it. TAB

N68-31348# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE METHOD OF INCREASING THE SPEED OF A DIGITAL DIFFERENTIAL ANALYZER WHEN SIMULATING COMPLEX POWER SYSTEMS [OB ODNOM SLOSOBE POVYSHENIYA BYSTRODEISTVIYA TSIFROVOGO DIFFERENTSIALNOGO ANALIZATORA PRI MODELIROVANII SLOZHNYKH ENERGOSISTEM]
P. G. Ali-Zade 14 Jul. 1967 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 6, 1965 p 37–41
(FTD-HT-23-797-67; AD-671134)

The remodeling of a sequential digital differential analyzer (DDA) is described which enhances the DDA operating speed and its suitability for studying electromechanical transients in power-supply systems; the remodeling requires very few additional devices. A system of algebraic and differential equations is considered

which describes the complicated transient processes arising in a power system upon a sudden disturbance (with an allowance for generator emf variations). The transient events are subdivided into 4 stages, and the calculating techniques for each stage are suggested; the disturbance may be represented by a short-circuit, automatic reclosing, cutting-off a stepped-out generator, etc. The overall speed of the DDA operation rises by 1.2–1.9 times depending on the type of problem. TAB

N68-31356# Illinois Univ., Urbana. Dept. of Computer Science.
VARIABLE SUCCESSIVE OVER-RELAXATION
Leland K. McDowell (Ph.D. Thesis) 18 Sep. 1967 63 p refs
(Grant NSF GP-4636)
(Rept.-244; PB-176955) CFSTI: HC $3.00/MF $0.65

The thesis investigates the solution of linear systems by extrapolated Gauss–Seidel iteration using a multiplicity of extrapolation parameters. This is a generalization of the method of successive over-relaxation, which uses a single scalar extrapolation parameter. The linear systems considered are those which arise in the numerical solution of boundary value problems for self-adjoint, elliptic partial differential equations. USGRDR

N68-31362# RAND Corp., Santa Monica, Calif.
BLOCK PROGRAMMING IN O/S-360 ASSEMBLY CODE
R. M. Balzer May 1968 10 p ref
(P-3810; AD-670503)

The document discusses block programming as a major facility in computer operations. TAB

N68-31364# Battelle Memorial Inst., Columbus, Ohio.
THE COMPILER FOR THE PROGRAMMING LANGUAGE FOR AUTOMATIC CHECKOUT EQUIPMENT (PLACE). PART 1: PLACE LANGUAGE AND COMPILER Final Report, 1 Dec. 1963–1 Dec. 1967
Burton H. Went Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. May 1968 138 p refs
(Contract AF 33(615)-1126)
(AFAPL-TR-68-27, Pt. 1; AD-670842)

PLACE (Programming Language for Automatic Checkout Equipment) was developed to provide (1) a language that could be used by engineers to program a variety of test systems, and (2) a language for which compilers could be developed quickly and inexpensively. The approach taken was to develop a basic programming language with which individuals closely associated with a particular checkout machine and checkout environment could easily develop both the statements to be used by engineers for checkout programming, and the compiler to translate the statements into code for the test system. Associated with the PLACE language is a computer program called the PLACE Processor which operates on the IBM 7094 computer. This program forms the major portion of the compiler for a checkout system. This report is devoted primarily to a formal description of the PLACE language, the detailed documentation of the PLACE Processor, and to a discussion of the use of the Processor in compiler development. Author (TAB)

N68-31369# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERAL PURPOSE CONTROL MACHINE, THE DNIPRO, AND ITS COMPILER
E. L. Yushchenko, B. N. Malinovskii, G. A. Polisnichuk, E. K. Yadrenko, and A. I. Nikitin Aug. 1967 251 p refs Transl. into ENGLISH of the book "Upravlyayushchaya Mashina Shirokogo Nazacheniya 'Dnipro' i Programmiruyushchaya Programma k Nei" Kiev, 1964 p 1–280
(FTD-MT-66-102; AD-671143)

The book gives in brief the engineering and mathematical description of DNIPRO, the multipurpose controlling computer, systems of automatic programming, fundamentals for the algorhythmic addressing language and systems of standard programs for the language etc. The book is intended as reference book for engineers and mathematicians who are working in the field of mathematical computation and algorhythmization of production processes and for students of corresponding fields. TAB

N68-31370*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
SPACEBORNE MEMORY ORGANIZATION, PHASE 1 Final Report
D. C. Gunderson, C. W. Hastings, and G. J. Prom Cambridge, Mass. NASA Electron. Res. Center Apr. 1968 122 p refs
(Contract NAS12-38)
(NASA-CR-86074; REPT.-12017-FR1) CFSTI: HC $3.00/MF $0.65
CSCL 09B

The application of associative memories to the data processing problems expected to be encountered on future space vehicles has been studied. Four problem areas considered in detail are (1) data acquisition and compression, (2) picture data processing, (3) incremented computation, and (4) miscellaneous control and memory functions present in multi-processor systems. An evaluation of the associative memory capabilities required for these and other applications was performed, and two associative memory organizational approaches are identified as being the most useful for space applications. A device rating system was also devised, and the devices suitable for each of four associative memory organizational approaches are rated. Author

N68-31379# Philco-Ford Corp., Blue Bell, Pa. Microelectronics Div.
R&D OF THE TECHNOLOGIES REQUIRED TO DESIGN AND FABRICATE ULTRAHIGH-SPEED COMPUTER SYSTEMS Interim Report, 1 Apr.–31 Dec. 1967
May 1968 80 p ref Prepared for Lincoln Lab., Mass. Inst. of Technol., Lexington
(Contract AF 19(628)-5167)
(IR-12; ESD-TR-68-90; AD-670855)

A research and development program directed toward the development of high speed computer subsystem fabrication technologies is described and the results of device yield and speed-power dissipation improvements are reported. Small geometry, shallow diffused, npn silicon transistors are utilized in simple ECL circuit forms to achieve high performance at low power dissipation in complex array structures. Various component interconnection technologies are being developed and characterized for high density, high speed subsystems. Multilevel single chip and multichip assemblies are being investigated. Reliability studies of functioning arrays have been initiated. Author (TAB)

N68-31388# Naval Ordnance Lab., White Oak, Md.
A CALCOMP PACKAGE FOR 3D PLOTTING
David J. Kennison Apr. 1968 64 p refs
(NOLTR-68-48; AD-671056)

A discussion is presented of a set of routines which allow the user to draw, using the CALCOMP 570 plotter, projections of three dimensional lines, curves, axes, and grids. The package may be used to produce red-and-green stereoscopic plots. All of the routines are written in FORTRAN IV for the IBM 7090, and are meant to be used under the IBSYS (Version 13) moniter. Author (TAB)

N68-31450# California Univ., Los Angeles. Engineering Dept.
MEMORY ALLOCATION IN COMPUTER SYSTEMS
Daniel Pierre Bovet Jun. 1968 200 p refs
(Contracts AT(11-1)-GEN-10; Nonr-233(52); ARPA SD-184)
(Rept.-68-17; AD-670499)

The problem of memory allocation for multiprocessed computational tasks is investigated. An a priori memory allocation

algorithm is developed which performs an efficient packing of space-taking entities into main memory and attempts to remove possible main memory overflows by automatically inserting transfer instructions into the program to be allocated. A dynamic memory allocation algorithm has also been proposed which allocates main memory space according to the current values of activity indicators associated with each space-taking entity in the given program and selects space-taking entities to be transferred to secondary memory using interaction factors between specified sets of vertices. Both memory allocation algorithms use directed bilogic graphs as models of the given computational task for which memory space must be allocated. Author (TAB)

N68-31453# Maryland Univ., College Park. Computer Science Center.
AN APPLICATION OF CLUSTER DETECTION TO TEXT AND PICTURE PROCESSING
Azriel Rosenfeld, Han K. Huang, (Natl. Biomed. Res. Found.), and Victor H. Schneider Jun. 1968 65 p
(Grant Nonr-5144(00))
(TR-68-68; AD-670612)

'Syntactic' information about a corpus of linguistic or pictorial data can be 'discovered' by analyzing the statistics of the data. Given a corpus of text, one can measure the tendencies of pairs of words to occur in common contexts, and use these measurements to define clusters of words. Applied to basic English text, this procedure yields clusters which correspond very closely to the traditional 'Parts of Speech (nouns, verbs, articles, etc.). For Fortran 'text', the clusters obtained correspond to integers, operations, etc.; for English text regarded as a sequence of letters (or of phonemes) rather than words, the vowels and the consonants are obtained as clusters. Finally, applied to the gray shades in a digitized picture, the procedure yields slice levels which appear to be useful for figure extraction. Author (TAB)

N68-31483# Maryland Univ., College Park. Computer Science Center.
COMPUTER DESIGN LANGUAGE. SIMULATION AND BOOLEAN TRANSLATION
Charles K. Mesztenyi Jun. 1968 99 p refs
(Grant NGL-21-002-008)
(TR-68-72)

The logical design of a digital computer, or digital device, can be described by a language termed the computer design language (CDL). Details are given on three program languages. These include: (1) the CDL which can be used as a standard language for describing the logic design of a digital system; (2) the simulator program that can test and debug the design on an existing computer; and (3) the Boolean Translator which generates the Boolean equations for each bit of the registers and memory words of the designed computer. Author

N68-31499*# North American Rockwell Corp., Anaheim, Calif.
STUDY OF SPACEBORNE MULTIPROCESSING, PHASE 2. VOLUME 1: SUMMARY
L. J. Koczela Washington NASA Aug. 1968 45 p ref
(Contract NAS12-108)
(NASA-CR-1158; C8-1476.22/33, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This final report presents the results of a research study of an advanced multiprocessor computer organization for future space missions. The organization is entitled the "Distributed Array Memory and Processor" computer. A manned Mars lander mission was selected as a representative mission for application and the computer requirements were developed. The organization developed utilizes an array of cells capable of a high degree of computational parallelism. The feasibility of such cells is dependent upon future LSI technology. Research was carried out in the hardware design and software analysis of this organization. This volume contains a summary of the results of the study. Author

N68-31563# Pennsylvania State Univ., University Park. Ordnance Research Lab.
THE INVESTIGATION OF PROBABILISTIC INTERCEPT PROBLEMS USING A DIGITALLY CONTROLLED ANALOG COMPUTER
J. B. Ross 9 Oct. 1967 134 p refs
(Contract NOw-65-0123-d)
(TM-215.2221-03; AD-670725)

An area of particular interest has been the distribution of intervals between axis-crossings. Increasing emphasis is placed on solving the zero-crossing problem which concerns the zeros of a continuous random function. A mathematical solution has yet to be accomplished. This thesis describes the digital system designed to measure the time between axis-crossings of a random process. The system is identified as a Time Interval Distribution Computer (TIDIC). At present, none of the probabilities or probability densities can be derived explicitly by analytical methods. Several approximations to the probability density as related to Gaussian processes have been formulated to date. In addition, a technical description of the measurement equipment and a brief survey of the progress to date are included. Also, experimental data is compared to the theoretical results. Author (TAB)

N68-31564# Pennsylvania State Univ., University Park. Ordnance Research Lab.
A TIME INTERVAL DISTRIBUTION COMPUTER
S. R. Gryczuk 15 Nov. 1967 125 p refs
(Contract NOw-65-0123-d)
(TM-215.2221-04; AD-670726)

An area of particular interest has been the distribution of intervals between axis-crossings. Increasing emphasis is placed on solving the zero-crossing problem which concerns the zeros of a continuous random function. A mathematical solution has yet to be accomplished. This thesis describes the digital system designed to measure the time between axis-crossings of a random process. The system is identified as a time interval distribution computer (TIDIC). At present, none of the probabilities or probability densities can be derived explicitly by analytical methods. Several approximations to the probability density as related to Gaussian processes have been formulated to date. In addition, a technical description of the measurement equipment and a brief survey of the progress to data are included. Also, experimental data is compared to the theoretical results. Author (TAB)

N68-31572# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton.
MODULAR ELECTRONIC DATA ACQUISITION SYSTEM FOR MAGNETOSTRICTIVE READOUT OF WIRE SPARK CHAMBERS
R. Bairstow and M. J. Cawthraw Dec. 1967 38 p
(RHEL/R-157) HMSO: 9s

A data handling system for use with wire spark chamber experiments, using magnetostrictive readout, is described here. It is made deliberately modular in concept and design to cater for any number of chambers. The data are stored in 16 bit, 30 MHz scalers, mounted on standard printed circuit boards carrying four scalers with readout logic. These are gated off in sequence according to the magnetostrictive signal input by six stage shift register blocks, four to a printed circuit. A standard assembly of 128 timing channels was designed capable of handling up to 36 inputs averaging three sparks each. Dual in-line digital integrated circuits were used throughout. Author (NSA)

N68-31587# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
AN IBM 360 VERSION OF THE NEUTRON DIFFUSION CODE CRAM
B. Mc Gregor, A. G. Richards, and R. G. J. Wood Feb. 1968 11 p
(AAEC/TM-429)

The AAEC 360 CRAM program, written in FORTRAN IV and ASSEMBLER, is designed to run under the 360 Operating System on a 256K model 50. The program can readily be changed to take advantage of additional storage that may be available on other 360 configurations. The code includes standard output routines as well as providing the user with the facility of including his own FORTRAN coded output routines. The code package includes sets of test problems for both one and two-dimensional geometries. Author (NSA)

N68-31623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGNING MAGNETIC ELEMENTS AND DEVICES OF ELECTRONIC COMPUTERS
Ye. P. Balashov 11 Aug. 1967 272 p refs Transl. into ENGLISH of the book "Proyektirovaniye Magnitnykh Elementov I Ustroystv Elektronnykh Vychislitel'nykh" Leningrad, Leningradskiy Elektrotekhn. Inst. Im. V. I. Ul'yanova, 1964 p 1-264
(FTD-MT-66-71; AD-671142)

A 262 page book devoted to the problem of systematizing informational material on the design and calculating of magnetic elements used in computers. The entire presentation is made on the basis of the contemporary concept of ferromagnetism. Examples are given of the calculation of separate elements and devices. Descriptive material is reduced to a minimum. Considerable attention is alloted to the characteristics of ferromagnetic materials and recommendation for their selection are given. Questions are considered in detail concerning the work of a core with a rectangular loop of hysteresis under different conditions. Analysis and method of designing ferrite-diode and ferrite-transistor elements which have enjoyed the greatest propagation in specialized devices for processing digital information. Magnetic elements of industrial manufacture are described. In the last chapter the author gives a method of designing magnetic storage units in cores with a rectangular loop of hysteresis, and separate questions are considered of the reliability of memory units on these elements. Author (TAB)

N68-31637# Weapons Research Establishment, Salisbury (Australia)
TWO METHODS FOR ANALOGUE TO DIGITAL CONVERSION
G. F. R. S. Hore Jun. 1968 21 p refs
(WRE-TN-WPD-76) CFSTI: HC$3.00/MF$0.65

Two basic types of analog to digital converter developed for presenting synchro data to a digital computer used in a weapon control system are discussed. Author

N68-31765*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED COMPUTER DESIGN TECHNIQUES FOR OPTICAL SYSTEMS
John M. McLauchlan *In* NASA. Marshall Space Flight Center Proc. of the Space Opt. Tech. Conf., vol. 1 Apr. 1966 p 51-57
(See N68-31759 19-07)

This paper describes experiences with a program for use on large computers, including the basic techniques, the capabilities, and the results obtained in some design efforts. The program does not make use of the classical aberration theories. The design function is accomplished by first tracing a set of rays through the optical system. Additional sets of rays for different object locations and indices of refraction are also traced. A figure of merit is calculated for these sets of rays from the sum of the rms spot sizes of the spot diagrams on a specified image surface. Additional criteria such as the correction of distortion can also enter into the determination of the figure of merit. Next, one of the parameters of the optical system that is to be determined is allowed to change by a small increment. The sets of rays are then retraced, and a new figure of merit is calculated. This process is repeated one at a time for the other parameters that are to be determined. Next, the amount that these parameters are to be simultaneously changed in order to minimize the figure of merit is computed by a least squares method. This represents one design cycle. Using the new values of the parameters the design cycle is repeated until no significant improvement is being made in the figure of merit. Author

N68-31776# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
TERMINATION OF ALGORITHMS
Zohar Manna (Ph.D. Thesis) Apr. 1968 105 p refs
(Contract ARPA SD-146)
(AFOSR-68-1302; AD-670558)

The thesis contains two parts which are self-contained units. In Part 1 we present several results on the relation between the problem of termination and equivalence of programs and abstract programs, and the first order predicate calculus. Part 2 is concerned with the relation between the termination of interpreted graphs, and properties of well-ordered sets and graph theory. Author (TAB)

N68-31781# Radio Corp. of America, Princeton, N. J. RCA Labs.
AN EVALUATION OF HEURISTICS FOR THRESHOLD-FUNCTION TEST-SYNTHESIS
Robert O. Winder May 1968 50 p refs
(Contract AF 49(638)-1184)
(SR-4; AFOSR-68-1297; AD-670556)

Linear programming offers the most attractive procedure for testing and obtaining optimal threshold gate realizations for functions generated in theoretical work, where the number of arguments ranges from 7 to 12, and the problem is to be solved by hand calculations. Certain initial reduction steps are known to be effective in reducing the number of column manipulations needed. A series of computer experiments were devised to evaluate their relative efficacy. The experiments also demonstrated the relative merits of several different values of pivot-choice; a new pair-pivot rule proved best in the most general case. Other experiments were run which gave additional heuristic insight into the operation of this family of linear programs. The design of the experiments may be of general interest to students of automatic problem solving; the results should be of interest in threshold logic and linear programming. Author (TAB)

N68-31801*# Harvard Univ., Cambridge, Mass. Engineering and Applied Physics Div.
THE MATRIX ALGEBRA PROGRAM. A CONVERSATIONAL LANGUAGE FOR NUMERICAL MATRIX OPERATIONS. PART 1: USER'S MANUAL
P. M. Newbold May 1968 46 p refs
(Grant NGR-22-007-068; Contract N00014-67-A-0298-0006)
(NASA-CR-96150; TR-561) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This user's manual is Part I of a two-part description of a new programming language MAP. The language is in a conversational mode, created expressly for direct-access time-sharing computer systems. It is designed to execute numerical matrix operations with the same ease and flexibility as scalar operations. No knowledge of any other language is required. Author

N68-31813 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ELECTRIC RESISTANCE ANALOG FOR HEAT TRANSFER STUDIES. PART 1: THE METHOD AND COMPUTER DESCRIPTION [ZASTOSOWANIE METODY ELEKTRYCZNEJ ANALOGII OPOROWEJ DO ZAGADNIEN PRZEPLYWU CIEPLA. CZESC 1: OPIS METODY I UKLADU ANALOGOWEGO]
A. Strupczewski 1968 54 p refs
(Rept.-901/XIA/R) CFSTI: $3.00

A new resistance-network analog computer for the solution of heat flow problems under transient conditions is described. In the computer, electrical networks represent the difference equations governing the problem to be solved. Temperature is represented by voltage, the spatial features of the problem by a network of parallel resistances, and the thermal constants by series resistances. A solution in steps Δt of time is obtained by successive readjustments of potentiometers supplying the voltages to the network. The method is very flexible, the time interval Δt and the thermal constants being adjustable during the progress of the work. The computer allows solution of problems involving heat transfer across a surface, or generation or absorption of heat in the interior of the system. One of the outstanding features of the computer is its stability, independent of the choice of time and thermal constants. Author

N68-31830# Radio Corp. of America, Princeton, N. J. RCA Labs.
PROBLEM-SOLVING PROCEDURES FOR EFFICIENT SYNTACTIC ANALYSIS
Saul Amarel May 1968 78 p refs Presented at the 20th ACM Natl. Conf., Cleveland, 24–26 Aug. 1965
(Contract AF 49(638)-1184)
(SR-1; AD-670575)

The main purpose of this report is to present a logical framework in which the syntactic analysis problem can be represented. This framework originates from previous work on problem-solving procedures for theorem proving. Procedures for syntactic analysis are represented as reduction procedures where a problem undergoes a sequence of nested transformations that result in a set of simpler subordinate problems whose solution implies the solution of the original problem. The representation of the syntactic analysis problem provides a unifying basis for expressing a variety of syntactic analysis procedures, both existing ones as well as new, proposed, procedures. Such a common basis contributes to a better understanding and systemization of the programming of syntax-directed compilers and of other translators whose source language is a context-free fragment of natural language, e.g., some question-answering systems. A useful concept of computational effort is defined, and it is used as a guide for the formulation of new efficient procedures. Heuristic procedures for syntactic analysis are suggested. Some features of these procedures are relevant to the design of advanced syntax-directed translators. Author (TAB)

N68-31839# Washington Univ., St. Louis, Mo. Computer Systems Lab.
A UNIFIED APPROACH TO THE DESIGN AND USE OF RESTRUCTURABLE COMPUTER SYSTEMS: THE META MACROMODULE MACHINE
Robert A. Ellis Jun. 1968 58 p refs
(Grant NIH FR-00218; ARPA ORDER SD-302)
(TR-7; AD-671195)

A restructurable computer system offers the user an evolutionary approach to the design and use of computer systems. To support this, a unified approach is proposed in this report. A meta machine and its environment are described which provide the ability to treat a macromodular description of a system as a program to be executed or as a set of specifications from which the system may be directly implemented in macromodules. Author (TAB)

N68-31844# Oak Ridge National Lab., Tenn.
MULTIANALYZER STORED PROGRAM DATA ACQUISITION SYETEM INTERFACE
E. Madden 27 Mar. 1968 31 p ref
(Contract W-7405-ENG-26)
(ORNL-TM-2153) CFSTI: HC $3.00/MF $0.65

An interface was constructed so that a Digital Equipment Corporation PDP-8 computer could be used as the experiment and data acquisition controller for a charged-particle detector system employing three solid-state detectors and flight-time analysis. The system is designed for use as a magnetic-tape analyzer. The system interface design concepts and details, input and output circuits and connections, interface operation requirements, and modifications to existing hardware are discussed. This system has been operational for more than 1 year. Author (NSA)

N68-31852# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH SPEED FERROMAGNETIC MEMORY UNITS
L. P. Krayzmer 28 Jul. 1967 415 p refs Transl. into ENGLISH of the book "Vystrodeystvuyushchiye Ferromagnitnyye Zapominayushchiye Ustroystva" Moscow, Izd. Energiya, 1964 p 1–371
(FTD-MT-66-62; AD-670721)

The book examines one of the more promising types of high-speed equipment for storage of discrete information--memory devices using ferromagnetic materials with a rectangular hysteresis loop. It describes the physical operating principles of memory elements, presents brief information on their fabrication and testing, and presents some input materials for calculation and design of computer memory devices. The book is intended for engineers working in the field of automation and computer technology and for researchers, graduate students, and advanced students of higher educational institutions of the appropriate profile. Author (TAB)

N68-31853# Carnegie-Mellon Univ., Pittsburgh, Pa.
ON COMPUTATIONAL SPEED-UP
Albert R. Meyer and Patrick C. Fischer (Brit. Columbia Univ.) May 1968 24 p refs
(Contract ARPA SD-146; Grant NSF GP-7701)
(AFOSR-68-1295; AD-670544)

The operator speed up in this paper establishes the existence of a computable function f such that for any program computing f(x) in a number of steps for all x, there is another program computing f(x) in a smaller number of steps. An example of speed up for Turing machines is considered. TAB

N68-31866# Battelle Memorial Inst., Columbus, Ohio.
THE COMPILER FOR THE PROGRAMMING LANGUAGE FOR AUTOMATIC CHECKOUT EQUIPMENT (PLACE). PART 2 APPENDIXES—DETAILED COMPILER DOCUMENTATION Final Report, 1 Dec. 1963–1 Dec. 1967
Burton H. Went Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. May 1968 573 p
(Contract AF 33(615)-1126)
(AFAPL-TR-68-27, Pt. 2; AD-670843)

Contains program listings and other detailed documentation of the compiler. TAB

N68-31892# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL RESEARCH Quarterly Technical Summary Report, 1 Feb.–30 Apr. 1968
Frederick C. Frick, V. Alexander Nedzel, Stephen H. Dodd, Melvin A. Herlin, and Jerome Freedman May 1968 56 p
(Contract AF 19(628)-5167)
(ESD-TR-68-83; AD-670832)

The Quarterly Technical Summary covers the period from 1 February through 30 April 1968. It consolidates the reports of Divisions 2 (Data Systems), Division 3 (Radio Physics), Division 4 (Radar), Division 7 (Engineering), and Division 8 (Solid State) on the General Research Program at Lincoln Laboratory. Author (TAB)

N68-31974# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
PMC: A GENERAL PURPOSE THREE-DIMENSIONAL MONTE CARLO CODE FOR THE IBM 7040 COMPUTER

R. A. Grimesey, C. W. Barner (Phillips Petrol. Co., Idaho Falls, Idaho), and S. Tong (United Technol. Center) Apr. 1968 114 p refs
(Contract AT(10-1)-1230)
(IN-1109) CFSTI: HC $3.00/MF $0.65

A three-dimensional Monte Carlo program, PMC, written in the MAP language for the IBM-7040 computer, is described. Output includes the scalar neutron flux integrals and reaction rates for resonant isotopes for an arbitrary energy group structure containing a minimum of approximations. The code is especially applicable to complex geometrical situations and areas where diffusion theory will be reliable. A statistical confidence is assigned to the results. Two versions of the program are described: a "nonresonant" version in which all cross sections are supplied in the input, and a "resonant" version in which resonant cross sections are computed directly. Simplified flow diagrams and sample problems showing the use of each version are given. Author (NSA)

N68-32055*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALOG COMPUTER SIMULATION OF A DC ARC EMISSION SPECTROMETER CONTROL SYSTEM TO DEFINE REQUIREMENTS FOR OPTIMUM CONTROL
Daniel J. Lesco Washington Aug. 1968 27 p refs
(NASA-TN-D-4770) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The use of an analog computer in the simulation of a dc arc and its control system is described. The detailed model design is presented. Control parameters determined with the model are shown to be optimum with the real system. Repeatability of system control to a programmed input to ±1 percent is achieved for both the model and the real system. Data from the model and the arc system show close agreement except in some areas of arc instability. Author

N68-32079# Washington Univ., St. Louis, Mo. Computer Systems Lab.
THE DESIGN OF A TAPE MACROMODULE
Warren M. Littlefield 15 Jun. 1967 96 p refs
(Contract ARPA SD-302; Grant NIH G-FR-00218; ARPA Order 655)
(TR-3; AD-668964)

This report deals with the design and function of a magnetic tape system module. The prototype was built out of MECL integrated logic and used in the pulse manner, and handles all those functions peculiar to the basic LINC tape transport. The system was interfaced and debugged on a LINC computer which was programmed to behave as a macromodular interface. Author (TAB)

N68-32102*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
FINAL REPORT ON PHASE 1 OF CONTRACT NAS12-140, DSR 55-27600
James Pennypacker Feb. 1967 28 p
(Contract NAS12-140; Proj. DSR 55-27600)
(NASA-CR-96154; E-2089) CFSTI: HC $3.00/MF $0.65 CSCL 09B

This report summarizes the work performed under a NASA contract to develop a computer aided design facility. The aim of the computer aided design facility is to provide the individual designer of digital electronic circuits with a tool to facilitate the design process. Typically, schematic drawings are to be automatically generated and signal and wire lists are to be printed. The facility incorporates a central data processor in which the design data is stored in a central file as the design proceeds; the data is immediately available for immediate recall in different forms specified by the designer. The threaded list structure of the central data file is described, as are the methods of manipulating data within the central file. The capabilities and limitations of the developed facility are examined, and a critique of the system is included. The overriding limitation to the practicality of the developed facility is the requirement of entering data via punched cards. Author

N68-32121# European Space Data Centre, Darmstadt (West Germany).
REDUCTION OF SATELLITE TELEMETRY DATA
W. Lloyd *In* ESRO Spacecraft Technol. Vol. 3; Nov. 1968 19 p *Its* Conf. No. 32 (See N68-32113 19-14)

Operation of a large computer is briefly recalled. Reduction of data received from Ariel 1 satellite is discussed and difficulties encountered are presented. Conclusions are drawn in an effort to improve data-reduction procedures. ESRO

N68-32159*# National Aeronautics and Space Administration, Washington, D. C.
VISUAL INFORMATION DISPLAY SYSTEMS, A SURVEY
1968 101 p refs Prepared by Auerbach Corp.
(NASA-SP-5049) GPO: HC $0.60; CFSTI: MF $0.65 CSCL 09B

Visual information display systems that are computer connected or updated with computer-generated information were surveyed, with emphasis on alphanumeric and graphic devices. Details are included for the three basic elements of display systems: (1) human beings and task dependent parameters; (2) hardware components such as cathode ray tubes, generators, screens, and man--machine reactive input devices; and (3) computer systems, programming and software development. Checkout and control are considered for large-scale checkout, ground monitor, and control systems. Interactive displays systems described include mathematical, design automation, and educational display systems. Reservation and information access systems are mentioned for on-line information storage and retrieval display systems; and Manned Spacecraft Center simulation displays, General Electric computed displays, and computer-produced movies are cited as simulation display systems. Cockpit displays and image enhancement are also discussed. Separate bibliographies are listed for each of the major topics considered in this survey. M.W.R.

N68-32164 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
THE ARITHMETIC OF SEMILOGARITHMIC NUMBERS. THE SUB-ROUTINES FOR UMC-1 COMPUTER [ARYTMETYKA LICZB POLLOGARYTMICZNYCH PODPROGRAMY DLA UMC-1]
Maria Makowska-Rzeszutko 1968 17 p In POLISH; ENGLISH summary
(INP-607/PL) CFSTI: $3.00

The meaning of the semilogarithmic number is defined, and the subroutines of addition, multiplication, and division of the semilogarithmic numbers are explained. The range of numbers of the UMC-1 computer is thereby enlarged to the following interval: $(-10 \cdot 10^{11453246122}, -1 \cdot 10^{-572823061}], 0, [1 \cdot 10^{-572823061}, 10 \cdot 10^{11453246122})$. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-30686*# Marquardt Corp., Van Nuys, Calif.
RESEARCH ON LOW VOLTAGE ELECTROLUMINESCENT DEVICES WITH STORAGE, PHASE 1 Final Report, 1 May 1967–29 Feb. 1968

R. W. Haas and J. M. Hanlet Feb. 1968 51 p refs
(Contract NAS12-545)
(NASA-CR-86060; Rept.-25252) CFSTI: HC $3.00/MF $0.65 CSCL 09A

To implement an electroluminescent display panel based upon the carrier injection phenomena, it is necessary to select an optimum material, an efficient device configuration, develop a method of fabrication that will produce the desired material properties, and investigate matrix interconnection. To initiate this program a material survey was conducted which compared general classes of materials with regard to spectral response related to band gap, type of band transition, and mobility. The survey indicated 2 and 6 compounds as the most desirable materials. An independent study considered the various tradeoffs of various device configurations and indicated that the heterojunction approach may be desirable for the selected materials. Various methods were investigated for avoiding the formation of native atomic vacancies during vacuum deposition and a new type of evaporating heater source was designed and tested for this purpose. Finally, a small matrix of discrete electroluminescent elements was constructed and tested to confirm the feasibility of the matrix interconnection. Author

N68-31130# Eitel-McCullough, Inc., San Carlos, Calif.
DEVELOPMENT OF LINEAR POWER TUBES Interim Development Report, 17 Feb.–16 May 1968
William E. Sain and Gordon E. Liljegren May 1968 45 p refs
(Contract N00024-67-C-1044)
(EIMAC-TR-68-14; AD-671077)

A total of nine X2012 tetrode - engineering models, using the EIMAC 4CX15,000A as a prototype, were built and tested. These models are designed to meet the requirements of Phase III (5000 to 15000 watts PEP output with a -40 db maximum third order intermodulation distortion). Of the nine engineering models built and tested, two of the tubes were X2012-Ns which proved to be the best model to date. For a given set of operating parameters, the X2012-N will give third and fifth order intermodulation distortion ratios of more than 45 db in the power output range from zero to 15000 watts ratios, but the fifth order intermodulation distortion ratio is approximately 3 db poorer than the results obtained with the X2012-N. Special tests were performed on the EIMAC 4CX15,000A and the X2012 models where screen voltage was varied linearly and in phase with the drive voltage. The effect of varying the screen voltage is to lower the zero signal plate current. A 7 per cent reduction in screen voltage at the idling point results in a 40 per cent reduction in zero signal plate dissipation. The intermodulation distortion ratios for the X2012-N are at least 42 db third order and 47 db fifth order when operated under this varying screen voltage conditions. Author (TAB)

N68-31241*# Electrocristal Corp., Inc., Washington, D. C.
THE DEVELOPMENT OF ANALOG PROBABILITY SWITCHES UTILIZING FERRIELECTRIC TRANSPOLARIZERS Final Report, May 1966–Mar. 1968
Charles F. Pulvari Feb. 1968 111 p refs
(Contract NAS12-136)
(NASA-CR-86087) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The formation of invariant features and their use in recognition, decision and control processes is a crucial problem. In this connection, the question arises what type of signal processing could bring us closer to a solution of this problem. An attempt was made to develop a new signal processor which is believed to hold considerable advantages over existing processors. The fact that signals, coming from the environment, normally do not provide information in a digitized form, and the transformation, storage as well as processing of such signals, requires a sizable addition of electronic hardware, strongly suggests that the direct processing of such signals of non-digital nature represented by multilevel samples offers considerable savings in electronic gear and provides advantages over digital processing. Author

N68-31388# Army Electronics Labs., Fort Monmouth, N. J.
ANALYSIS OF COOLING METHODS
M. H. Zinn Mar. 1968 18 p refs
(ECOM-2947; AD-670922)

Experimental results have shown that a beam power density of 1667 watts/sq cm can be dissipated in an electrode which consists of a narrow bore tubing, if the tubing is filled with copper mesh to a 20% density and water at a low rate is passed through the tubing. It is shown that this high power density can be dissipated because the mesh surface area is sufficient to drop the power density at the point of transfer to the coolant to a density less than or equal to 135 watts/sq cm. The surface of the mesh is effective due to some combination, yet to be determined, of thermal conductivity of the mesh and vapor transport. An experiment designed to verify the proposed mechanism and determine the contribution of the mesh thermal conductivity is planned for the next phase of the study. The results of this experiment will allow the extrapolation of the results to other electrode geometries. Author (TAB)

N68-31444# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A HIGH PRECISION LOGARITHMIC AMPLIFIER USING SAMPLING TECHNIQUES
Lawrence R. Simmering 1 Dec. 1967 39 p refs
(Contract F19628-67-C-0301)
(SR-313; AFCRL-68-0191; AD-671150)

An analysis and design of a versatile periodic sampling logarithmic amplifier is presented. The design uses the decay of a voltage in an RC network to generate a precise logarithmic response and employs the cascading of several stages to increase the dynamic range of the design. Accuracies greater than those obtained by the common approximation methods are obtained. Author (TAB)

N68-31461*# Leach Corp., Azusa, Calif. Controls Div.
ENDLESS LOOP RECORDER SERVO CONTROL UNIT Final Report
12 Dec. 1967 57 p
(Contract NAS5-9445)
(NASA-CR-95952; Rept.-23) CFSTI: $3.00 CSCL 09F

Details are given on a study leading to a brushless DC motor servo used in conjunction with a dejittering buffer was completed. The study was conducted on an endless loop recorder intended for space applications where minimum power, weight, size, and maximum reliability are paramount considerations. An open loop tape drive system, utilizing a hysteresis AC motor, was found to be satisfactory for the record mode of operation, thereby eliminating the need for a tone wheel or similar device as a part of system requirements. Using a phase-locked servo technique in the playback mode, a servo bandwidth of 70 Hz was achieved. Analysis of the tape flutter spectrum above 70 Hz during closed loop operation of the servo led to determination of size requirements for dejittering buffer. The buffer, used to effectively remove the jitter components left uncompensated by the servo, has a data capacity of 8 bits. The combined compensation techniques will enable the data to be clocked out of a space vehicle recorder with a crystal or other stable oscillator, thereby eliminating time base error (jitter) normally encountered with a tape recorder. Author

N68-31487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECTS OF POTASSIUM AND SODIUM CONTENTS IN THE CERAMIC SUBSTRATE ON THE LOAD LIVES OF FILM RESISTORS
You-gen Wu and lun-chung Gao 31 Aug. 1967 17 p refs
Transl. into ENGLISH from Tien Tzu Hsueh Pao (Peking), no. 4, 1964 p 98–104
(FTD-HT-67-242; AD-670901)

Several film-resistor materials and the general requirements for the surface of the substrate are described. The insulation

resistance of several substrates was measured. The effects of various substrates upon the load lives of three kinds of film resistors were investigated. It has been pointed out from the tests of the metal film resistor that the initial changes of the resistance were semipermanent on DC load and the electrochemical corrosion of the films was gradual and relatively long. This effect had much to do with the test conditions and could be slowed down by derating. The different of Na(+) and K(+) in the substrate showed quite different effects. This paper presents some possible methods for improving the DC aging performance of film resistors. By comparing the load lives of the newer and older substrates, it is considered to be very effective to add alkali-earth metal oxides as the flux for a ceramic substrate. Author (TAB)

N68-31539# Compagnie Francaise Thomson-Houston, Paris (France).
PHOTOCONDUCTING TELEVISION CAMERA TUBE WITH NEAR ULTRAVIOLET IMAGE AMPLIFICATION [ETUDE D'UN TUBE DE PRISE DE VUES DE TELEVISION PHOTOCONDUCTEUR A SECTION AMPLIFICATRICE D'IMAGE SENSIBLE DANS LE PROCHE ULTRAVIOLET]
M. Blamoutier *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 104–120 (See N68-31528 19-23)

Design and operation characteristics of a vidicon image tube, responsive device, and an ultraviolet are described. It is formed of a cesium telluride photocathode, an image electrostatic focusing device, and an electrostatic focusing and deflection gun forming a strong instrument compatible with launching conditions. Sensitivity, spectral response, time and resolution measurements are discussed as well as the utilization of such a tube in space astronomical programs. ESRO

N68-31540# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
C.N.E.S. INVESTIGATION OF TELEVISION CAMERA TUBES [ENQUETE C.N.E.S. SUR LES TUBES DE PRISE DE VUE TELEVISION]
C. L. Guillard *In Its* Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 121–128 refs (See N68-31528 19-23)

Scientific, technological and technical conditions imposed on television camera tubes for spaceborne use are analyzed. A brief enumeration of characteristics of existing tubes is given. ESRO

N68-31541# Radiotechnique S. A., Suresnes (France).
PHOTOMULTIPLIERS AND IONIZATION CHAMBERS FOR FAR ULTRAVIOLET RADIATION [PHOTOMULTIPLICATEURS ET CHAMBRES A IONISATION POUR L'ULTRAVIOLET LOINTAIN]
R. Petit *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 130–143 (See N68-31528 19-23)

Ultraviolet sensitive tubes are requested for space research. Photomultipliers and ionization chambers have been developed. Problems of the sealing of the aperture window, and photocathode fabrication are discussed. An ionization chamber is described and the influence of the voltage applied is analyzed. ESRO

N68-31597*# Texas Instruments, Inc., Dallas.
HIGH-SPEED MICROPOWER MICROELECTRONIC LOGIC CIRCUITS Final Technical Documentary Report, 18 May 1967–18 Jun. 1968
R. Stehlin 18 Jun. 1968 139 p refs
(Contract NAS1-7106)
(NASA-CR-66644; Rept.-03-68-31) CFSTI: HC $3.00/MF $0.65
CSCL 09A

Details are given on the development of complementary transistor–transistor logic (CT^2L) for use at high speeds (2 MHz), while maintaining very low worst-case standby power (300 μW). Also described is the development of three circuits and their fabrication by the master bar approach. They are: (1) a single-6 input NAND gate, (2) a dual-3 input NAND gate, and (3) a J-K flip–flop. Results have shown that CT^2L logic can be used as a high-speed logic at micropower levels. The circuits operate at a 200 μW level at 50 kHz and have worst-case standby powers of less than 300 μW. Operating frequencies of over 2.0 MHz have been obtained at these power levels. The NAND gates exhibit a power-speed product of 14 picojoules and the flip–flops have power-speed product of 9 picojoules. Two methods of obtaining complementary transistors in integrated form are described. Both the n–p–n and p–n–p devices have excellent matched low-current characteristics. These devices have application in the linear field as well as the digital field. Author

N68-31618# Army Electronics Labs., Fort Monmouth, N. J.
ELECTRONICALLY TUNABLE UP-CONVERTER
William P. Dattilo Jan. 1968 57 p refs
(ECOM-2908; AD-670921)

The design of an electronically tunable microwave filter is presented. The device is an upper-sideband up-converter which is tuned by varying the pump frequency so that the output frequency is constant. The input frequency band is from 500 MHz to 1000 MHz; the pump frequency band is from 7.237 GHz to 7.737 GHz; and the output frequency is at 8.237 GHz. A matching network is described which minimizes the pump power required for suitable operation. The measured maximum and minimum values of gain of the device across the 500-MHz tuning range are 2.0 dB and 0.6 dB respectively and the pump power is 30 milliwatts maximum. Author (TAB)

N68-31619# Army Electronics Labs., Fort Monmouth, N. J.
PREPARATION OF THIN-FILM SILICON DIOXIDE BY RF SPUTTERING
I. H. Pratt Apr. 1968 46 p refs
(ECOM-2968; AD-670920)

The results of a study on the deposition of thin-film silicon dioxide by RF sputtering are discussed. The dielectric source material was quartz which was sputtered and deposited onto aluminum electrodes and counterelectroded to complete the metal-oxide-metal capacitive structures. Depositions were conducted at pressures from 1-20 x 10 to the -3 power torr utilizing a triode type sputtering system wherein the processes of ionization of the gas and bombardment of the material are separated essentially. An electron beam is used to ionize the gas and produce the plasma. Application of an RF voltage (13.560 MHz) to a conducting plate placed behind the dielectric (quartz) plate translates the RF power by displacement current through the insulating source material. Interaction of RF voltage and plasma results in the establishment of a dc field between source and plasma which allows for the sputtering of the insulator. The capacitors were utilized to evaluate the dielectric, the device characteristics, and related process parameters. The effect of gas sputtering pressure, magnetic field strength, source-to-substrate distance, and power density on the rate of deposition is shown. Increased film thickness uniformity over a 3 in x 3 in area by optimum substrate positioning is indicated. Dielectric constant, dissipation factor, dielectric breakdown strength, insulation resistance, heat treatment, capacitance and dissipation factor over the range 400 Hz to 5 MHz, and effect of coating on thin-film resistive elements are reported. Author (TAB)

N68-31828# Rome Air Development Center, Griffiss AFB, N. Y.
A STUDY OF THE TIME DOMAIN RESPONSE FOR A BOXCAR GENERATOR
Joseph G. Schatz Jun. 1968 46 p refs
(RADC-TR-68-147; AD-670586)

The purpose of this report is to present a detailed time domain analysis of a boxcar generator. The basic analysis of the unit is presented and extended to obtain results for various input modulation waveshapes. In addition, a set of criteria is derived under which the unit functions as a demodulator. Author (TAB)

N68-31869# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THICK FILM LAYOUT CONSIDERATIONS
Robert E. McMahon and Helmut H. Pichler 12 Apr. 1968 14 p
(Contract AF 19(628)-5167)
(TN-1968-13; ESD-TR-68-59; AD-670573)

The technical note describes the preliminary layout considerations for thick film materials. The available and improved materials are discussed and their related electrical characteristics are listed. Resolution and power dissipation relationships are also presented. Author (TAB)

N68-31874# Army Electronics Lab., Fort Monmouth, N. J.
VISIBLE DISPLAYS OF MILLIMETER WAVE RADIATION FROM REFLECTING TARGETS
Harold Jacobs, James D. Schumacher, and David Register Apr. 1968 49 p refs
(ECOM-2965; AD-670926)

An extension of work on converting mm wave images into visible displays is reported. Three improved factors are noted. (1) Imaging has been carried out with reflecting targets. This is relevant to almost all applications in which the image conversion device is applicable. (2) The thickness of the semiconductor modulating panel which is the key element in the imaging process has been optimized. (3) Using a multiple collector system, the angle of view has been increased to 12 degrees as compared with the single horn collector system, which had an angle of view of only 6 degrees. Author (TAB)

N68-31964# Army Electronics Labs., Fort Monmouth, N. J.
TECHNIQUES FOR FABRICATION SCANNABLE COLD CATHODES
Dietrich Dobischek and Nelson D. Dent Mar. 1968 57 p refs
(ECOM-2948; AD-670925)

Experiments were made with Field Emission Type of Cathodes. The formation of asperities was demonstrated on plain molybdenum layers using the aluminum alloying technique. It was found that too little aluminum fails to produce asperities whereas an excess of aluminum results in irregular corrosion of the molybdenum surface. Experiments in which asperities were grown on molybdenum areas confined by insulating layers showed that the presence of these layers may affect the formation of asperities. Alumina inhibited the growth of asperities in the immediate vicinity of the alumina layer. Silicon monoxide did not appear to adversely influence the formation of asperities. Experiments were made with Transverse-Field Type of Cathodes. The preparation of transverse-field type of cathodes was explored using various cathode configurations, materials and techniques. Vacuum deposition methods were found to be superior to spray-coating techniques in the preparation of the cathodes. Cathode configurations in which the gap between the two conductors was controlled by an insulating film sandwiched between the conductors appeared to be the most promising approach toward the fabrication of a useful cathode. Difficulties were experienced with such structures from short circuits between the conducting layers. It was concluded that these failures were not necessarily caused by defects of the insulating layer, but that, in some instances, the two conductors may have come in direct contact inside the structure due to a mismatch of the thicknesses of the insulating layer and the base electrode. The feasibility of preparing a BaO film such as to carry an electron current across the gap of a cathode structure was demonstrated. Author (TAB)

N68-31977# Army Electronics Labs., Fort Monmouth, N. J.
TRANSIENT SIMULATOR
Dennis W. Bowman and Gregory J. Malinowski Mar. 1968 20 p refs
(ECOM-2953; AD-670923)

The report describes the design and operation of a transient voltage simulator used in the evaluation of voltage transient suppressor circuits or networks such as zener shunt, linear series regulators or cut-off type regulators. The simulator is capable of high current pulses variable in amplitude and duration. The report also shows the performance of the simulator as designed and recommends future modifications for added versatility. Author (TAB)

N68-32124# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
A HALL PROBE MAGNETIC FIELD METER [UN MISURATORE DI CAMPO MAGNETICO A SONDA DI HALL]
M. Placidi, F. Soso, and M. Vescovi 28 May 1968 18 p refs In ITALIAN *Its* Nota Interna No. 401
(LNF-68/30) CFSTI: HC $3.00/MF $0.65

The construction of a magnetic field meter, using a Hall probe, is described. The instrument which is variable with time, provides a tension proportional to the field strength, and is stable and consistant. Although the construction is simple, the results are considered very precise. Transl. by F.O.S.

N68-32167 Institute of Nuclear Research, Warsaw (Poland).
AN ANALYSIS OF THE COMPENSATION METHOD OF DIFFERENTIAL AMPLIFIER WORKING IN STABILIZED DC LOW VOLTAGE SUPPLY [ANALIZA KOMPENSACJI TEMPERATUROWEJ WZMACNIACZA ROZNICOWEGO PRACUJACEGO W UKLADZIE REGULACJI ZASILACZA STABILIZOWANEGO]
Ryszard Bayer and Teresa Koba 1968 18 p refs In POLISH; ENGLISH summary
(Rept.-899/III/E) CFSTI: $3.00

The temperature compensation method of differential amplifiers working with stabilized dc low voltage supply is described. The method is based on mutual compensation of temperature changes of Zener diode voltage and parameters of transistors working in differential amplifiers. The average output voltage temperature coefficient obtained is 10^{-5}/°C, which is one order of magnitude better than in typical Zener diode voltage compensation with normal diodes. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-30915 George Washington Univ., Washington, D. C.
AN RC SINGLE TRANSISTOR TWO PORT SYNTHESIS TECHNIQUE
Arnold Charles Meltzer (Ph.D. Thesis) 1967 169 p Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-11773

A synthesis procedure is developed which will realize any stable two-circuit voltage transfer function of a lumped, linear, finite, passive, and bilateral network using only resistors, capacitors (RC), a single transistor, and no inductors. The resultant network has a common ground topology and will realize a transfer function to within a gain constant which can be determined from the transfer function. Criteria and existing techniques for passive and active resistance-capacitance synthesis methods are reviewed. The constraints of various topologies and active devices are reviewed to determine their effect on the particular design procedure. Comparisons of various known passive- and active-RC synthesis techniques are shown. A new RC-active synthesis technique which uses a single transistor is developed. The simulation of a synthesized network on a digital computer in order to verify that the network actually realized the given voltage transfer function is also discussed. Dissert. Abstr.

N68-30969# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
MINIMUM MEAN-SQUARE ERROR STOCHASTIC LINEAR CONTROL
J. S. Meditch Apr. 1968 34 p refs
(DI-82-0693; Rept.-17; AD-671047)

Optimal control algorithms are developed for discrete and continuous time stochastic linear dynamical systems for an instantaneous weighted mean-square error performance measure. The derivations are based on well-known results in matrix analysis and the theory of stochastic linear systems. Cases where the system disturbance and/or the measurement error processes are each time-correlated are considered, and the original optimal control algorithms are modified to handle such cases. The results are attractive for on-line control applications since they require no precomputation. Stability analysis remains as a problem for future study. Author (TAB)

N68-30970# Naval Avionics Facility, Indianapolis, Ind.
STANDARD HARDWARE PROGRAM MIN-TERM GENERATOR MODULE
Leo F. Welsh Apr. 1968 41 p
(NAFI-TR-1207; AD-671072)

The report describes a voltage and pin programmable function generator of the min-term type. Two complete min-term generators are contained in one Standard Hardware Program (SHP) Size 1A module. Any logic function of three input variables is obtained by the voltage or pin programming of the eight control inputs on either of the min-term generators. This permits more efficient implementation of control logic than is possible with the interconnection of individual gates with all inputs and outputs brought out to individual pins. It also permits dynamic function changes through use of voltage programming. Author (TAB)

N68-31079# RAND Corp., Santa Monica, Calif.
OPTIMUM CONTROL OF LINEAR, SAMPLED DATA SYSTEMS WITH INACCESSIBLE STATE VARIABLES
J. G. Root May 1968 20 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5655-PR; AD-670569)

Some new results in the optimum control of linear systems with respect to a quadratic performance criterion are given. It is assumed that the system is subject to additive random disturbances and that some state variables cannot be measured or can only be measured with additive noise. It is well known that when the disturbance and noise are normal random variables, the optimum controller is a linear function of the minimum mean squared estimates for the state variables. In this study the result is shown to hold without qualification. Author (TAB)

N68-31089 Illinois Univ., Urbana.
AN EQUIVALENT GAIN AND STOCHASTIC ANALYSIS FOR NONLINEAR SAMPLED-DATA CONTROL SYSTEMS
Roi Francis Prueher, Jr., (Ph.D. Thesis) 1967 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-11905

A generalized equivalent gain function for nonlinear sampled-data control systems (NLSD) is defined and is specified to be the ratio of the z-transform of the cross-correlation function of the system input and output signals to the z-transform of the autocorrelation function of the system input signal. Although this definition can be used to derive the usual describing function when the input is sinusoidal, it is not restricted to the sinusoidal case. In the past, the techniques of describing function analysis have been helpful in nonlinear analysis and have furnished valid results. The nonlinear element is first considered as an isolated element. The output signal from the nonlinear element consists of a series of impulses. The stochastic input case also represents an extension of the describing function method of analysis. An analog computer simulation study of a nonlinear sampled-data system with a dead-zone relay nonlinearity is used to illustrate the analytically derived results. Dissert. Abstr.

N68-31114# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
APPLICATION OF HIGH POWER SOLID-STATE ELECTRONICS TO ELECTRIC PROPULSION
Richard D. Thornton, David H. Navon, J. Lichtenberger, C. Erdelyi, and E. Miller 4 Oct. 1967 67 p refs
(Contract C-85-65)
(PB-176920) CFSTI: HC $3.00/MF $0.65

The work reported here is concerned with the application of high power electronics to electric propulsion. During the last year the effort has been in two main areas: (1) development of improved high power semi-conductor switches and (2) the development of lightweight, low inductance machines which are well matched to semi-conductor device capabilities. USGRDR

N68-31134 Illinois Univ., Urbana.
SUBOPTIMAL FEEDBACK CONTROL OF SYSTEMS WITH RANDOM PARAMETERS
Ronald Alfred Werner (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-11934

This thesis relates the theory of optimal control with the concept of sensitivity. It deals with the following problem. Suppose one wants to design an optimal controller for a system that has a variable input and contains unknown random parameters. The controller must generate an optimal control for each allowed input and all allowed values of the random parameters. However, the controller cannot measure the parameters directly; it can only measure the input to the system and the output of the system. Hence, it is a feedback controller that generates the optimal control for all allowed inputs and systems. A method for finding a suboptimal solution is a partial sum of an infinite series that converges to the optimal solution. Dissert. Abstr.

N68-31171# RAND Corp., Santa Monica, Calif.
OPTIMAL CONTROL OF A DISCRETE TIME STOCHASTIC SYSTEM LINEAR IN THE STATE
Joseph L. Midler Apr. 1968 12 p refs
(P-3631-1; AD-668749)

Consideration is given to a discrete time finite horizon stochastic control problem whose dynamic equations and loss function are linear in the state vector with random coefficients, but which may vary in a nonlinear, random manner with the control variables. The controls are constrained to lie in a given set. For this system we have the rather surprising result that the optimal control or policy is independent of the value of the state. This fact follows from a simple dynamic programming argument concerning the form of the optimal return function. Under suitable restrictions on the functions, the dynamic programming approach leads to efficient computational methods for obtaining the controls via a sequence of mathematical programming problems in fewer variables than the number of controls in the entire process. The result extends the notion of certainty equivalence for a sequential stochastic decision problem. The expectations of the random functions play the role of certainty equivalents in the sense that the optimal control can be found by solving a deterministic problem in which expectations replace random quantities. Author (TAB)

N68-31179 Rice Univ., Houston, Tex.
ON JOINT ESTIMATION OF THE STATE AND PARAMETERS FOR AN AUTONOMOUS LINEAR SYSTEM BASED ON MEASUREMENTS CONTAINING NOISE

Terrance Magoun Carney (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-13057

Joint estimation of the state and parameters of an autonomous linear dynamical system with forcing based on a finite sequence of measurements containing noise was studied. The nonlinear estimation problem is approached from two points of view. First, nonlinear estimators are constructed for maximum likelihood and least squares performance criteria, where the least squares estimator is developed both in the time domain and, by a Fourier transform technique, in the frequency domain. Second, the model is linearized to enable application of the well-known Kalman–Bucy estimator in two versions, one based on a single initial choice of reference for linearization and one which relinearizes based on the current estimate after each measurement. The maximum likelihood estimator gave the best performance uniformly. The Kalman–Bucy estimator with relinearization gave comparable performance except where the measurement error had a very small a priori variance. The least squares estimators gave substantially the same results in the time and frequency domains, and performed well when the a priori error in the state and parameters was small but poorly in the converse case. Dissert. Abstr.

N68-31217 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF A VARIABLE STRUCTURE REGULATOR FOR FACILITATING THE LATERAL STABILITY OF AN AIRCRAFT
M. A. Bermant, M. B. Gritsenko, M. Ya. Zubkov, and V. F. Mavritsyn 23 Jul. 1968 22 p refs Transl. into ENGLISH from the Russian Rept., 1968 p 297–311
(JPRS-45964) CFSTI: $3.00

An automatic device is synthesized as a variable structure regulator for implementing the lateral stability of an aircraft that has directional instability and low damping. The device permits almost aperiodic transitional processes in the aircraft system based on the control signals and under the effects of wind perturbation. There is a zero static error in the system, which is invariant to the external perturbing influences of yawing and rolling moments. M.W.R.

N68-31380# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A DIGITALLY CONTROLLED SATELLITE FREQUENCY SYNTHESIZER
John B. Connolly 9 Apr. 1968 33 p refs
(Contract AF 19(628)-5167)
(TN-1968-12; ESD-TR-68-55; AD-670854)

This report considers two well-known methods of frequency synthesis, the VCO approach and the modular or iterative mix-filter-divide approach from the point of view of use in the Lincoln Experimental Satellite (LES) series. System parameters are chosen and a specific implementation is described. Author (TAB)

N68-31494*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
A MAXIMUM PRINCIPLE FOR OPTIMAL CONTROL PROBLEMS WITH FUNCTIONAL DIFFERENTIAL SYSTEMS
H. T. Banks [1968] 7 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GP-9024)
(NASA-CR-95958) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A maximum principle is presented in integral form for solving optimal control problems with delay-differential system equations and with delays in the control. Vector matrix notation is used without distinguishing between a vector and its transpose. N-vector functionals are assumed, and a solution is offered in which there is a Lebesque point and a non-trivial n-vector function of bounded variation that is continuous at this point. Proof for this involves showing that the class of functions is absolutely quasiconvex and using the necessary conditions for extremals. M.W.R.

N68-31500*# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
RECURSIVE ALGORITHMS FOR PATTERN CLASSIFICATION USING MISCLASSIFIED SAMPLES
R. L. Kashyap Jun. 1968 13 p refs
(Grants NGL-15-005-021; NSF GK-1970)
(NASA-CR-96120; TR-EE-68-14) CFSTI: HC $3.00/MF $0.65 CSCL 09C

We consider the samples x(i) belonging to one of the two non-overlapping classes, ω_1 and ω_0, which possess a separating function f(x). The observed membership of pattern x(i) is represented by the variable z(i) which can assume only one of two values, ± 1, or $z(i) = [\text{sgn } f(x(i))]\eta(i)$ where $\eta(i)$ is the measurement noise and $E(\eta)$ is known. Thus the membership of the training samples may be erroneous. Using only the available sample pairs $[x(i), z(i)]$, $i = 1, 2, \ldots$, we will obtain an optimal approximation to the separating function f(x). Author

N68-31617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROGRESS IN AUTOMATION ENGINEERING
Ching-hsuan Hsueh 29 Sep. 1967 29 p Transl. into ENGLISH from Tzu Tung Hua Chi Shu Chin Chan (Communist China), no. 1, 1963 p 52–74
(FTD-HT-67-356; AD-670874)

The theory of pulse control for the study of pulse controlled and digital controlled systems is considered. The first part of the paper deals with the theory on linear pulse control which includes studies on linear pulse controlled systems under stable and random processes. The second part treats the nonlinear theory which includes studies on digital controlled systems. TAB

N68-31655*# Philco-Ford Corp., Blue Bell, Pa. Microelectronics Div.
STUDY OF FAILURE MODES OF MULTILEVEL LARGE SCALE INTEGRATED CIRCUITS Interim Scientific Report, 15 Oct. 1967–14 Apr. 1968
Earl S. Schlegel May 1968 144 p refs
(Contract NAS12-544)
(NASA-CR-86088; ISR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Empirical and theoretical investigations have resulted in techniques for improving the reliability and performance of large-scale multilevel microcircuit arrays. The detailed behavior and effects of surface ions have been measured as a function of applied voltage, temperature, time, humidity and the testing history of the device. The model for surface ion behavior has been extended to include the case in which the surface ion density is a function of the surface potential of the oxide. Vapor deposited oxides have been extensively studied to establish their value as second-layer oxides for multilevel microcircuitry. The use of phosphorus as an additive to vapor plated oxide layers has been shown to improve the reproducibility and the stability of the electrical properties of vapor plated oxides. A broad review has been prepared of each of the factors that should be considered in a program to develop and produce highly reliable large scale multilevel microcircuit arrays. A number of ways are suggested for including test structures in production microcircuit wafers for process control, and for analyses of yield and reliability problems. Author

N68-31689# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
LARGE SIGNAL COMPUTER ANALYSIS OF KLYSTRON WAVES
Sven Wallander Dec. 1967 29 p refs
(Contract AF 61(052)-890)
(RADC-TR-68-249; TN-3; RR-78; AD-671153)

A simple method is developed for computer experiments on the disc model of the confined electron beam. The ac beam

current components of the lowest harmonics in the two-resonator klystron are studied. A number of hollow and solid beam geometries are investigated. The maximum obtainable relative ac current amplitudes are in general larger (a) in thin beams than in wide beams (b) in beams inside a conducting tube than in beams without tube (c) in solid beams than in hollow beams. Author (TAB)

N68-31809# Bell Aerosystems Corp., Buffalo, N. Y.
OPTIMAL AND SUBOPTIMAL PROPERTIES OF A TWO-TIME-SCALE CONTROL SYSTEM USING ADAPTIVE MODELING Annual Progress Report, 15 Jun. 1967–14 Jun. 1968
Frederic D. Powell 14 Jun. 1968 73 p refs
(Contract Nonr-4864(00))
(Rept.-9500-920126; APR-3; AD-670624)

Adaptive modeling of plants with unobservable states and unknown dynamics is employed to enable simultaneous estimation of the plants dynamics and state. A variety of control methods may then be applied; among these is a class of control systems employing two time scales. This class of control systems is considered in the present research effort and is the subject of this report. Given the state and dynamics of the plant, it is possible to estimate the future trajectory of the plant due to present state and present control. The future trajectory of the system error may then be estimated and a control increment may be synthesized to extremize performance indices including these future trajectory data. The report presents the properties of this class of control systems, demonstrates the validity of gradient laws for synthesizing the optimal control and shows the consequences on system dynamics of optimal and suboptimal instrumentation of the control law which this principle yields. The method is generalized to multi-input multi-output plants of unknown dynamics, to performance indices of more general form, and to synthesis of optimal and suboptimal control sequences. The analytical results are supported by analog simulation experiments on a variety of stable and unstable plants. Author (TAB)

N68-31810# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
ACTIVE RC SYNTHESIS TECHNIQUES FOR SIGNIFICANT REACTANCE REDUCTION
Isaac M. Horowitz (Hughes Aircraft Co., Culver City, Calif.) and George R. Branner Mar. 1968 12 p ref Presented at the 10th Midwest Symp. on Circuit Theory, Lafayette, Ind., 18–19 May 1967 Prepared jointly with Hughes Aircraft Co., Culver City, Calif.
(Contract AF 33(615)-2639)
(AFAL-TR-67-349; AD-670859)

Many developments in the field of active RC synthesis have been motivated exclusively by the desire to eliminate the necessity of inductance (by utilization of the active element). Recently, and to an increasing extent with the advent of molecular electronics, considerable attention has been given to the problem of overall system sensitivity to component variations. The need for reactance reduction arises in the design of immittance functions which involve poles relatively close to the origin in combination with low system impedance levels. This report is concerned with a solution to the following problem: design an RC circuit for specified low input and output resistance such that the final network contains small values of reactance and minimizes circuit sensitivity. Author (TAB)

N68-31822# RAND Corp., Santa Monica, Calif.
OPTIMAL CONTROL OF A DISCRETE-TIME STOCHASTIC SYSTEM LINEAR IN THE STATE
Joseph L. Midler Aug. 1967 10 p refs Presented at 6th Intern. Symp. on Mathematical Programming, Princeton, N. J., 14–18 Aug. 1967
(P-3631)

A discrete-time stochastic control problem is considered whose dynamic equations and loss function are linear in the state vector with random coefficients, but which may vary in a nonlinear, random manner with the control variables. The controls are constrained to lie in a given set. It is shown that the optimal control or policy is independent of the value of the state. The result follows from a simple dynamic programming argument and extends earlier work where random variables were assumed to have only a finite number of realizations; here they may be continuous. Under suitable restrictions on the functions, the dynamic programming approach leads to efficient computational methods for obtaining the controls via a sequence of mathematical programming problems in fewer variables than the number of controls in the entire process. The result provides an instance of certainty equivalence for a stochastic problem. The expectations of the random variables play the role of certainty equivalents in that optimal control can be found by solving a deterministic problem in which expectations replace the random quantities. Author

N68-31823# Washington Univ., Seattle. Dept. of Electrical Engineering.
MODULARITY IN DESIGN: THE APPLICATION OF SHIFT REGISTERS IN SECONDARY STATE ASSIGNMENT
Kenneth H. O'Keefe Jan. 1968 102 p refs
(Grant AF-AFOSR-939-68)
(AFOSR-68-1300; AD-670550)

The report introduces a method of synthesis of digital systems and develops a theory by which this new concept may be applied to problems of both theoretical and practical significance. The particular instrument chosen to illustrate the theory is a set of modules or building blocks, viz., shift registers of equal length. It is shown that this module type has certain properties (not found in binary building blocks) which are common to the general digital building block and therefore the development here represents a first step in obtaining a theory for system design using non-binary modules. Author (TAB)

N68-31861# Naval Research Lab., Washington, D. C.
NOISE FILTERING IMPROVEMENTS
Charles F. White 8 May 1968 19 p
(NRL-6720; AD-671181)

Electrical noise filtering with augmented low pass resistance-capacitance networks provides reduced signal lags and steady-state biases as compared with those characteristic of the simple RC noise filter. These improvements apply, e.g., to airborne weapons control systems in which the displayed aim dot position errors must be minimal. Rate gyro output and system noise filtering, when required, is advantageously accomplished with the augmented RC low pass network. Author (TAB)

N68-31997# Columbia Univ., New York.
LINEAR PROGRAMMING AND THE RELIABILITY OF MULTICOMPONENT SYSTEMS
Peter J. Kolesar Washington Office of Naval Res. Sep. 1967 12 p refs Repr. from Naval Res. Logistics Quarterly, v. 14, no. 3, Sep. 1967 p 317–327
(Contract Nonr-(55))
(NAVSO-P-1278; AD-659652)

Several problems in the assignment of parallel redundant components to systems composed of elements subject to failure are considered. In each case the problem is to make an assignment which maximizes the system reliability subject to system constraints. Three distinct problems are treated. The first is the classical problem of maximizing system reliability under total cost or weight constraints when components are subject to a single type of failure. The second problem deals with components which are subject to two types of failure and minimizes the probability of one mode of system failure subject to a constraint on the probability of the other mode of system failure. The third problem deals with components which may either fail to operate or may operate prematurely. System reliability is maximized subject to a constraint on system safety. In each case the problem is formulated as an

integer linear program. This has an advantage over alternative dynamic programming formulations in that standard algorithms may be employed to obtain numerical results. Author (TAB)

N68-32049*# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
THEORY OF COMPLEX SYSTEMS WITH A HIERARCHICAL CONTROL STRUCTURE [O TEORII SLOZHNYKH SISTEM S IYERARKHICHESKOY STRUKTUROY UPRAVLENIYA]
A. I. Kukhtenko NASA Jul. 1968 15 p refs Transl. into ENGLISH from the Publ. "Slozhnyye Sistemy Upravleniya" Kiev, Naukova Dumka Press, 1966 p 6–20
(Contract NASw-1693)
(NASA-TT-F-11412) CFSTI: HC$3.00/MF$0.65 CSCL 09C

Various aspects associated with complex control systems subjected to a hierarchical structure of control objects with an imposed universal criterion of optimality are discussed. It is suggested that a system of absolutely complex control objects can have a predetermined structure and sufficient a priori information to allow a mathematical description of the system whether by a clearly determined relationship or a probability relationship. Once the structure of the system is known and equations for the system elements are given, the problem can be treated in terms of the known concepts of automatic control. The characteristic problems arising in complex control systems are reviewed. An example of a system having a hierarchical structure is discussed in terms of a multiaircraft control system. The principal features of this type of a system are discussed. Author

N68-32067# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
AUTOMATIC CONTROL SYSTEMS FOR LEGGED LOCOMOTION MACHINES
Andrew Alfonso Frank May 1968 182 p refs
(Grants AF-AFOSR-496-67; AF-AFOSR-67-1018A)
(USCEE-273; AFOSR-68-1340; AD-670601)

The report is concerned with the limb coordination control problem for animals and legged vehicles. After a general survey of previous work in the area, a discussion of the mechanical, control and computer aspects of the problem is presented. This is followed by a development of several theoretical models for legged locomotion systems and a subsequent determination of the properties of these models. In particular, a necessary and sufficient condition for the stability of low speed locomotion is established. It is shown that only three of the 5040 theoretically possible gaits for quadrupeds satisfy this condition. The theoretical results on stability are used as a basis for synthesising a simple finite state control algorithm for two different gaits. The ability of these algorithms to produce stable locomotion is verified by the construction and successful testing of a small artificial quadruped with eight independently powered joints coordinated by a small purpose digital computer. Author (TAB)

N68-32173 Institute of Nuclear Research, Warsaw (Poland).
DETERMINATION OF STATISTICAL PARAMETERS OF THE DOUBLE-TRIPLE COINCIDENCE CIRCUIT [OKRESLENIE PARAMETROW STATYSTYCZNYCH UKLADU KOINCYDENCJI PODOWOJNO-POTROJNYCH]
J. Kalisz 1968 19 p refs In POLISH; ENGLISH summary
(Rept.-904/III/E) CFSTI: $3.00

A triple coincidence circuit is considered, which consists of two double coincidence circuits connected in series. The probability density of registration time of the "first" double coincidence circuit and the coincidence curve of the whole triple coincidence circuit are determined analytically. Two methods are presented for determination of statistical parameters of the double-triple coincidence circuit on the basis of the empirical coincidence curve. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-31009# Joint Publications Research Service, Washington, D. C.
PRINCIPLES OF AUTOMATIC CONTROL INCREASE ACCELERATOR ENERGY
A. L. Mints 31 Jul. 1968 14 p refs Transl. into ENGLISH from Priroda (Moscow), no. 12, Apr. 1968 p 8–15
(JPRS-46039)

The characteristics, capacities, and limitations of existing linear and cyclic particle accelerators are reviewed, including those of the 70-BeV Serpukhov proton accelerator and the 30-BeV accelerators at Brookhaven, U.S.A., and Geneva, Switzerland. Based on the current state of the art, the feasibility and design considerations are discussed for the construction of proton accelerators with an energy up to 1000 BeV. This is to be achieved by the principle of automatic self-correction of the magnetic field and a three-stage system consisting of a linear accelerator (a 200-MeV proton injector), an intermediate cyclic booster increasing the particle energy from 200 MeV to 6 BeV, and a large cyclic system where the energy is raised to 1000 BeV. The construction of a 1-BeV cybernetic accelerator which is to serve as a working model for the 1000-BeV unit is described. K.W.

N68-31223*# Firestone Tire and Rubber Co., Akron, Ohio. Defense Research Div.
DESIGN, DEVELOPMENT AND TESTING OF BI-EXPLOSIVE SHAPED CHARGE METEORITIC SIMULATORS
Apr. 1968 155 p refs
(Contract NAS1-6886)
(NASA-CR-66615) CFSTI: HC$3.00/MF$0.65 CSCL 14B

The results of a contract to develop meteoritic simulators using shaped charge techniques are presented. Explosive wave shaping theory is discussed and radiographs of firing tests are shown. The effect of material properties such as purity and grain size on shaped charge jet formation and integrity is explored. It is concluded that the acceleration of single pellets of two grams mass to velocities of about 12 km/sec is feasible. Author

N68-31232# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
ELECTROMAGNETIC ISOTOPE SEPARATOR, MAGNETIC MEASURES, RESULTS [LE SEPARATEUR ELECTROMAGNETIQUE D'ISOTOPES, MESURES MAGNETIQUES, RESULTATS]
Marc Boge and André Baud (Oerlikon Soc.) Jan. 1968 20 p refs In FRENCH; ENGLISH summary
(CEA-R-3444) CFSTI: HC$3.00/MF$0.65

The electromagnetic isotope separator of the University of Grenoble can produce isotopes with a great purity. It has two identical magnets with an inhomogeneous field. The magnetic fields have been corrected with shims in order to obtain an accuracy of $\pm 10^{-4}$ in the useful region. These shims have been determined experimentally by measurements. The great enrichment factors obtained prove the quality of this apparatus. Author (ESRO)

N68-31592*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TEST SECTIONS FOR SMALL THEORETICAL WIND-TUNNEL-BOUNDARY INTERFERENCE ON V/STOL MODELS

Ray H. Wright. Washington, Aug. 1968. 85 p. refs.
(NASA-TR-286) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A wind-tunnel test section with closed upper wall, slotted side walls, and open lower boundary was found theoretically to produce zero tunnel-boundary lift interference on a small wing with horizontal wake mounted at the center of the test section. For this test section the variation of the interference with angle of the vortex wake behind a high-lift-coefficient model was not large. Because of the small slot widths required for zero interference and of the effects of boundary layer, the theory is regarded as unreliable for predicting the slot widths required; however, the variation of the interference with the slot width for widths somewhat greater than those needed for zero interference was found to be small. The interference in the region likely to be occupied by the tail of a model was investigated in some detail and was found to change with slot width and with wake angle more strongly than did the interference at the lifting element. A limited investigation of the lift interference in a test section with closed upper wall and slotted side and lower boundaries was made to obtain the theoretically indicated slot width required for zero lift interference at a center-mounted wing with the wake horizontal. Author

N68-31607# National Inst. for Metallurgy, Johannesburg (South Africa).
COMPENSATING FOR FLUX VARIATION IN NEUTRON ACTIVATION ANALYSIS
K. Lowe, P. K. Faure, and T. W. Steele. 3 Jul. 1967. 31 p. refs.
(NIM-177)

The design and construction of equipment that will automatically compensate for flux changes during the neutron irradiation of samples are described. A circuit that is an electrical analog of the physical phenomenon was constructed, and was used to indicate electrically the exact amount of activity in the sample at any time. A switching circuit that starts the counting when the activity of the irradiated sample has decayed to a predetermined level is incorporated. Preliminary tests indicate that use of the circuit improves the statistics of the results. The circuit can easily be used with any existing neutron generator and ratemeter. Author (NSA)

N68-31609# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
RADIAL ACCEPTANCE OF 10 MEV PROTON LINEAR ACCELERATOR IN SWIERK
Eugeniusz Dziura. 1967. 22 p. refs.
(INR-834/SLBAL/PL)

In order to find the input data for the calculation of the optical beam matching system between the 0.5-MeV Cockcroft–Walton injector and 10-MeV proton linear accelerator in Swierk, three alternatives of focusing system arrangements have been calculated. The (0 + − − + + . . .) arrangement is shown as the only one applicable. For the chosen quadrupole field strength law and with the rigorous assumption that the magnetic lengths of the lenses are equal to their geometrical lengths the following numbers were obtained: cos Θ = 0.788 and F = 70 mrad mm. Author (NSA)

N68-31652# National Physical Lab., Teddington (England). Aerodynamics Div.
THE APPLICATION OF MASKELL'S THEORY OF WIND-TUNNEL BLOCKAGE TO VERY LARGE SOLID MODELS
C. F. Cowdrey. Oct. 1967. 13 p. refs.
(NPL-AERO-1247) CFSTI: HC $3.00/MF $0.65

The theory of bluff-body wind-tunnel blockage proposed by Maskell is discussed, with particular reference to very large models in the form of rectangular blocks. Some force measurements on two such models of different sizes are compared to illustrate the order of accuracy to be expected. Author

N68-31685# Weapons Research Establishment, Salisbury (Australia).
CHARACTERISTICS OF A GAS SCRUBBER FOR USE WITH HELIUM AS THE CARRIER GAS
G. Lee. May 1968. 12 p. refs.
(WRE-TN-DWD-12) CFSTI: HC $3.00/MF $0.65

To determine the flow characteristics of a gas scrubber at high flowrates of helium, separate tests were carried out using air and helium, and the results are compared with previous results using nitrogen. Author

N68-31670# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
NEUTRON GENERATING TUBES
D. Timus. 1967. 76 p. refs.
(IFA-AL-1)

A brief review of the various methods used for production of neutrons is presented. Various aspects are then discussed with respect to neutron generating tubes. These are targets; accelerating gap; gas replenisher; classification, ion sources, and parameters of existing neutron generating tubes; power supplies; and applications. N5A

N68-31694# British Aircraft Corp., Preston (England).
THE EFFECT OF A DEAD-SPACE ON THE LATERAL CONTROL LOOP
A. G. Barnes and M. Ormerod. May 1968. 37 p. refs.
(Contract KD/3D/21/C.B.5)
(S&T-MEMO-5/68) CFSTI: HC $3.00/MF $0.65

Describes an investigation to improve understanding of the shortcomings of ground based flight simulators. The resolution of displayed signals is generally not as good as in real flight and may adversely affect simulation. To verify this hypothesis, the effects on closed loop stability of a dead-space in bank and heading feedback is studied, both for autopilot and piloted control. It is shown that low frequency limit cycles result, the amplitudes of which are proportional to the size of dead-space. Author

N68-31725# Navy Undersea Warfare Center, San Diego, Calif. Dept. of Ocean Sciences.
NUWC TEMPERATURE CALIBRATION FACILITY. RECENT IMPROVEMENTS AND INTERORGANIZATIONAL CROSS CALIBRATION RESULTS Research Report, Oct. 1958–Mar. 1967
C. D. Curtis. 8 Feb. 1968. 44 p. refs.
(NUWC-TP-27; AD-671193)

Describes the improvements effected during the last ten years, which have made the facility more accurate and versatile. Includes the results of an interorganizational cross-calibration program for reversing thermometers. Author (TAB)

N68-31849# Aeronautical Research Labs., Melbourne (Australia).
RANDOM NOISE FATIGUE MACHINE (ELECTRONIC INSTRUMENTATION, PART 1)
C. W. Sutton and D. A. Pender. Aug. 1968. 47 p. refs.
(ARL/INST.-66) CFSTI: HC $3.00/MF $0.65

Electronic circuitry is described which will simulate random force loadings on a specimen of aircraft material similar to those experienced by the specimen under flight conditions. The equipment is designed for continuous operation to allow the specimen to be excited until fatigue failure occurs. Author

N68-31902# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
RELATIVISTIC RING CYCLOTRON WITH STRONG FOCUSING [RELYATIVISTSKII KOL'TSEVOI TSIKLOTRON S ZHESTKOI FOKUSIROVKOI]

V. N. Anosov, A. T. Vasilenko, S. B. Vorozhtsov et al 1968 9 p refs In RUSSIAN Submitted for Publication
(JINR-P9-3787)

The main parameters of the electron model of the relativistic ring cyclotron with strong focusing, which was put into operation in the JINR Laboratory of Nuclear Problems, are given. The model is intended for investigation of dynamic acceleration processes as well as the effects of collective particle interaction in high-current proton accelerators with the internal beam current up to hundreds of mA. Author (NSA)

N68-31913*# Techtran Corp., Glen Burnie, Md.
MULTIPLE AND RAPID PRESSURE MEASUREMENTS IN WIND TUNNELS [MESURES MULTIPLES ET RAPIDES DES PRESSIONS EN SOUFFLERIE]
J. Fiquet Washington NASA Mar. 1968 9 p Transl. into ENGLISH of ONERA-TP-451 Rept. Presented at the Mesucora Congr., Paris, 17–21 Apr. 1967
(Contract NASw-1695)
(NASA-TT-F-11508) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A modern installation is described for taking many pressure measurements in wind tunnels. This equipment has electronically controlled pneumatic switches and a built-in electric cap, differential amplifiers, a numerical voltmeter, logic units for data handling and processing, and a tape perforator. The calibration bench built to calibrate this measurement circuit is briefly described. An example of industrial testing performed with this equipment in a wind tunnel is given. Author

N68-31942# California Univ., Berkeley. Lawrence Radiation Lab.
SOLENOID HAVING A HORIZONTAL AXIS AND A ROOM-TEMPERATURE APERTURE
Robert B. Meuser, William H. Chamberlain, and Ronald E. Hintz Apr. 1968 18 p Presented at the 20th Intern. Cryogenic Eng. Conf., Brighton, Engl., 7–10 May 1968
(Contract W-7405-ENG-48)
(UCRL-18179; CONF-680505-3) CFSTI: HC $3.00/MF $0.65

A solenoid having a horizontal axis and room temperature aperture has been built. The overall length is 43 inches and the clear bore diameter is 4.25 inches. It contains 38,770 turns of Nb–48% Ti wire having a 0.015–inch diameter core and a 0.030–inch diameter copper sheath. At the quenching current of 111 A, which is within about 10% of the short sample value, the current density, based on the coil envelope, is 16.6 kA/cm^2, and the peak field is 65.5 kG. Author (NSA)

N68-31971# Cambridge Electron Accelerator, Mass.
A COMPARISON OF CEA AND SLAC FARADAY CUP CALIBRATION BY MEANS OF A SECONDARY EMISSION MONITOR
George F. Dell and Mircea Fotino 23 May 1968 18 p refs Presented at the Symp. on Beam Intensity Meas. at the Daresbury Nucl. Phys. Lab., Daresbury, Engl., 22–26 Apr. 1968
(Contract AT(30-1)-2076)
(CEAL-1043; CONF-680430-2) CFSTI: HC $3.00/MF $0.65

A comparison of the beam monitoring devices used at CEA and SLAC is presented. Gold-plated aluminum foils were used as secondary emission monitors, and the Faraday cups used at both laboratories are described. NSA

N68-32025*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SYSTEM VALIDATION TEST, LEM CREW COMPARTMENT COOLING UNIT, LAUNCH COMPLEX 37, LAUNCH AREA B
Eugene H. Roberts 8 Jan. 1968 44 p
(NASA-TM-X-61146; TR-598) CFSTI: HC $3.00/MF $0.65 CSCL 22D

This report presents a summary of the Unit and Systems Validation Testing performed on the LEM CREW COMPARTMENT COOLING UNIT and the complete LEM CREW COMPARTMENT COOLING SYSTEM as installed on the Launch Complex 37 Service Structure. Based on the test data obtained and the method of test performed, the system was considered acceptable to the procuring agency. Author

N68-32119# European Space Technology Center, Delft (Netherlands).
LAUNCHING BASE ORGANIZATION [ORGANIZATION D'UN CHAMP DE TIR]
J. B. Lagarde *In* ESRO Spacecraft Technol. Vol. 3: Nov. 1966 18 p In FRENCH *Its* Conf. No. 30 (See N68-32113 19-14)

Functions performed at Kiruna before, during and after a rocket launch are summarized. ESRO

N68-32120# European Space Technology Center, Delft (Netherlands).
ORGANIZATION OF A NETWORK OF STATIONS FOR THE ACQUISITION OF SATELLITE DATA
G. C. Tootil *In* ESRO Spacecraft Technol. Vol. 3: Nov. 1966 9 p Conf. No. 31 (See N68-32113 19-14)

This paper outlines the organization which ESRO has set up to gather and process unmanned scientific satellite data. ESRO

N68-32129*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JET PROPULSION LABORATORY HIGH-INTENSITY ACOUSTIC TEST SYSTEM
15 Jun. 1967 23 p
(Contract NAS7-100)
(NASA-CR-95991; JPL-TM-33-349) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The high intensity acoustic test system was developed in order to provide high intensity, broadband acoustic environments under both reverberant and progressive wave conditions, for the performance of acoustic environmental tests. The system is used for both developmental and flight qualification tests of spacecraft and their components as well as for research and development studies. It consists of both reverberation and progressive wave test chambers, with an input capability of broadband noise and discrete frequency signals. The reverberation chambers are designed to provide maximum sound diffusion and the system has maximum spectrum-shaping capabilities as well as very accurate control of input test signals. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-30874 Washington Univ., Seattle.
VELOCITY PROFILES IN FLOW THROUGH SMALL TUBES
Leon Oscar Billig (Ph.D. Thesis) 1967 199 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-14150

The rheology of non-Newtonian fluids has become a subject of increasing study in recent years. In areas of technology ranging from hydraulic dredging to the petro-chemical industry, the Newtonian fluid model is being replaced by more realistic, usually empirical models that permit more accurate predictions of flow

behavior. In the biological field, the non-Newtonian behavior is of particular interest because circulatory disturbances of various kinds account for a large percentage of the deaths that occur in this country each year. The present study was prompted by the need for more information on the flow mechanisms of blood. A numerical method for performing the calculations was developed and programmed for a digital computer. The new method successfully retrieved velocity profiles from temperature profiles calculated from the classical Graetz solution and by Kaye' numerical method. The method was tested experimentally using water, ethylene glycol, and mineral oil flowing through a 1.1 mm stainless steel tube. Test results are given and compared with theory. Dissert. Abstr.

N68-30911 Oklahoma Univ., Norman.
FLOW INSTABILITY THRESHOLDS IN A NATURAL CIRCUATION LOOP
Billy Jay Walker (Ph.D. Thesis) 1967 241 p
Available from Univ. Microfilms: HC $11.05/MF $3.15 Order No. 67-12008

An analytical and experimental investigation was made of the flow instability threshold in a closed natural-circulation loop. The density effect model formulated by Boure was utilized to predict the instability threshold in terms of dimensionless parameters. Comparison with experimental data showed that the model which is based on large density changes as the sole driving mechanism for the oscillations was sufficiently accurate to predict pressure and flow instabilities. The various vibrational modes of the loop were calculated and compared with the experimental oscillations. Results showed that the loop tended to vibrate at frequencies comparable to the natural frequencies of the various modes of vibration of the loop. Dissert. Abstr

N68-30925 Rice Univ., Houston, Tex.
DIFFUSION IN PULSATING FLOW IN A CONDUIT
Estrella B. Fagela-Alabastro (Ph.D. Thesis) 1967 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13050

The effect of periodic, small amplitude disturbances superimposed on a steady laminar flow in a conduit on the rate of mass transfer to the wall is investigated. Two physical models are considered in this study. The first pertains to flow in a rigid conduit with a pressure gradient disturbance which is a periodic function of time only. The second case deals with flow in a distensible tube which is longitudinally constrained so that there is no movement of the tube wall in the axial direction. The steady laminar flow is disturbed by a wave progressing in the direction of flow. The results of the calculations indicate that the time-averaged local Nusselt number is a function of the frequency and amplitude of the disturbance, the location along the axis of the conduit and the ratio of the steady mean velocity U_o to the wave velocity C. The change in the Time-averaged local Nusselt number over the steady state value is positive beyond a critical frequency and becomes zero at infinite frequency. However, at low frequencies the results are surprisingly different. The pulsations cause the Nusselt number to be less than that of the steady flow case. Dissert. Abstr.

N68-30935 Washington Univ., Seattle.
AN INVESTIGATION OF THE RHEOLOGICAL PROPERTIES OF SOLID-LIQUID SUSPENSIONS
Luis Walter Pommier (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-14211

It is suggested that solid liquid systems may be classified into static suspensions, those formed by spherical particles of identical density and diameter and which remain in a fixed position with respect to a fixed coordinate system and dynamic suspensions those similarly formed, but which move with respect to a fixed coordinate system. Only properties of static suspensions were studied in detail. Special techniques were developed to measure the density of static suspensions and on the bases of the results obtained it was suggested that the solide of the system constitute a crystal-like lattice with a face center cubic structure oriented with its (1,1,1) plane perpendicular to the direction of flow of the rising liquid. The stability of the static suspensions was studied on the basis of a relationship between the coefficient of drag and Reynolds number of the suspending liquid. Dissert. Abstr.

N68-30980 Cornell Univ., Ithaca, N. Y.
ASYMPTOTIC EXPANSIONS AT VANISHINGLY SMALL VISCOSITY FOR THE CONSTANT VORTICITY FLOW OVER AN INFINITE WEDGE
Leonidas Serevo Pindo De Abreu (Ph.D. Thesis) 1967 208 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-12324

The method of matched asymptotic expansions was applied to the problem of a steady, incompressible, viscous, constant outer vorticity flow over an infinite wedge. Two asymptotic expansions for the stream function were devised, one valid in the outer region and the other in the inner (boundary-layer) region. The matching between the inner and outer expansions was performed by the application of the usual "asymptotic matching principle." The region of interest was restricted to a neighborhood of the leading edge of the wedge, where the interaction between the boundary layer and the outer vorticity produces only a second-order effect. The range of validity of the solutions was examined, and expressions were given for some of the quantities needed in practical calculations; namely, the shear stress at the wall, the pressure gradient at the edge of the boundary layer and the tangential and normal inner-velocities. Dissert. Abstr.

N68-30988 Colorado Univ., Boulder.
THE VISCOUS-INVISCID HYPERSONIC FLOW OF A PERFECT GAS OVER SMOOTH SYMMETRIC BODIES
Sherman Keith Jackson (Ph.D. Thesis) 1966 205 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-10051

A simple numerical method for rapidly and accurately computing the inviscid hypersonic flow of a perfect gas around "smooth" axisymmetric or two-dimensional bodies is developed. The present method evolves from an approximation suggested by S. H. Maslen, and uses the value of the stream function and the distance along the shock wave as independent variables. The same method is used in both the subsonic and supersonic portions of the inviscid flow field, and is combined with an appropriate boundary-layer analysis to provide a description of the complete viscous-inviscid flow. Several results including both inviscid and viscous-inviscid interaction calculations are presented to illustrate the scope and accuracy of the method. It is found that in a wide variety of cases accuracies are obtained which are comparable to the more exact numerical techniques now available, with a significant reduction in computing time. Dissert. Abstr.

N68-31004 Kansas State Univ., Manhattan.
BOUNDARY LAYER BEHAVIOR ON CONTINUOUS MOVING SURFACES
Virgil Grant Fox (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-13944

The boundary layer flow considered is induced by the steady rectilinear motion of an unending solid surface as it issues from a die into a quiescent fluid. Both flat and cylindrical moving continuous surfaces are studied. The boundary layer for this problem originates at the die and grows in the direction of the movement of the continuous surface. First, the laminar boundary layer equations of momentum, temperature, and concentration for a moving continuous flat sheet with suction and injection are investigated by

approximate methods. Second, the behavior of the velocity field for a moving continuous flat sheet immersed in a power law, non-Newtonian fluid is studied. Third, the velocity field which exists near a moving continuous circular cylinder is investigated. Fourth, several additional research subjects are proposed with emphasis being placed on numerical techniques and circular geometry. The idea of using quasi-linearization to solve the boundary layer equations is explored and possible experimental studies are also presented. Dissert. Abstr.

N68-31010# Delaware Univ., Newark.
KELVIN–HELMHOLTZ AND POINT OF INFLECTION INSTABILITIES IN STRATIFIED FLOWS NEAR A SOLID BOUNDARY
Richard Dale Swope (Ph.D. Thesis) 1966 191 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-11740

Kelvin–Helmholtz and point of inflection instabilities are examined for hydrodynamic systems in which an interface forms between a uniformly streaming fluid of one density and a boundary-layer-like flow of fluid of another density. Situations in which only Kelvin–Helmholtz instabilities occur, as well as those in which the possibility of simultaneous occurrences of the two types of instabilities is allowed, are considered. Surface tension and buoyant forces are included in the analysis. The mathematical formulation is cast in the form of a linear, normal mode, stability analysis of stratified fluids. The resulting differential equations and boundary conditions are solved and a characteristic equation results. The nature of the eigenvalues of this equation and thus, the nature of the stability of the configuration in question is determined by utilizing a combination of exact and approximate techniques. Dissert. Abstr.

N68-31013 Rensselaer Polytechnic Inst., Troy, N. Y.
A STUDY OF SOME NON-NEWTONIAN FLUIDS IN ISOTROPIC TURBULENCE
Pao-Liu Chow (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12832

The present study consists of three major parts. Firstly, some general considerations in connection with non-Newtonian turbulence are presented. The next investigation is concerned with the decay of isotropic turbulence in a class of viscoelastic fluids of a type characterized by a constitutive equation of Oldroyd. It is assumed that the elasticity is small in comparison with the viscosity so that a perturbation method based on a small parameter can be used. The last study deals with the initial and final periods of decay in the Oldroyd type of fluid used before. Dissert. Abstr.

N68-31030 Johns Hopkins Univ., Baltimore, Md.
A PHENOMENOLOGICAL THEORY OF QUASI-PARALLEL TURBULENT SHEAR FLOW
Victor Wai-Tsu Nee (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-13818

The mean velocity and mean shear stress distribution of the two-dimensional quasi-parallel turbulent shear flow is calculated using the assumption that the effective turbulent viscosity, ϵ, obeys a rate equation. The effects of generation, convection, diffusion and decay of the turbulence are each represented by proper terms in that rate equation. Thus, together with the equation of motion, they form a closed system for the two dependent variables; ϵ the effective viscosity and U the mean velocity. From the rate equation, Prandtl's Mixing Length Theory can be deduced as a limiting case. For the case of the turbulent non-turbulent interface at the outer edge of the boundary layer, analytical results were obtained. The constant shear flow near the wall is also treated and the solution agrees with the well-known experimental result at least qualitatively. Similarly solutions for incompressible turbulent boundary layers with no pressure gradient, were calculated assuming a linear growth of the turbulent boundary layer and an additional simple assumption concerning the convection terms was used. Results for the distribution of the mean velocity, total shear stress and turbulent viscosity have been obtained and comparison was made with available experiments. Dissert. Abstr.

N68-31031 Polytechnic Inst. of Brooklyn, N. Y.
TWO-DIMENSIONAL PROBLEMS OF LINEARIZED RADIATIVE GASDYNAMICS
Myron Sydney Wecker (Ph.D. Thesis) 1967 71 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-13428

Solutions of multi-dimensional radiative gasdynamics problems available in the literature have in general been limited to the regime of very weak or very strong radiation, or optically thin or thick gases. One notable exception, valid throughout the entire range of radiation strength and gas absorptivity, utilized the spherical-harmonic approximation and presented the solution for the flow of an inviscid, radiating, gray gas over a small-amplitude wavy wall. The work reported on here extends and utilizes the wavy wall solution as the basis for Fourier synthesis of linearized radiative flows over other wall shapes. Solutions are presented, in terms of integrals which must in general be evaluated numerically, for perturbation velocities throughout the flow field. Two problems, including the flow over a compressive or expansive corner, are analyzed in detail; the streamwise velocity perturbations at the wall are calculated numerically and in asymptotic form. Dissert. Abstr.

N68-31037 Louisiana State Univ., Baton Rouge.
FLOW LOSSES IN FLEXIBLE HOSE
Kenneth Lloyd Riley (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-14008

The objective of this study was to develop an empirical method for predicting flow losses in flexible metal hose. Hoses with annular and helical convolutions were used. The correlations developed in this study, for both straight and curved hose, relate the Fanning friction factor with Reynolds number and hose geometry. Results indicate that two correlations are necessary: one for annular-type hose and another for helical-type hose. These correlations are presented both graphically and mathematically. For a given hose the flow behavior can be described by considering the friction factor as a function of Reynolds number. For Reynolds numbers in the lower end of the turbulent flow regime (10,000 to about 70,000), the friction factor is independent of Reynolds number and has a value of about 0.020. As the flow rate increases above this range the friction factor begins to increase with an increase in Reynolds number. At very high Reynolds numbers the friction factor again becomes independent of the Reynolds number. The correlation for curved hose has been found to be applicable for both annular and helical hoses. Dissert. Abstr.

N68-31053# Aeronautical Research Council (Gt. Brit.).
THE MEASUREMENT OF SKIN FRICTION IN SUPERSONIC FLOW BY MEANS OF HEATED THIN FILM GAUGES
B. J. Bellhouse and D. L. Schultz 1968 11 p refs Supersedes Oxford Univ., Dept. of Eng. Sci. Rept.-1002, ARC-27402 (ARC-R&M-3490; PD-3600; Rept.-1002; ARC-27402; AD-833448) CFSTI: HC $3.00/MF $0.65

The application of heated thin film gauges to the measurement of mean skin friction in compressible flow is described. It is shown that the calibration of the gauges in independent of Mach number, at least up to M = 3, provided the fluid properties are calculated at the appropriate film temperature. The gauges are calibrated by reference to surface tubes and also by comparison with the theoretical solution of Spalding and Chi. Author (TAB)

N68-31072# Wisconsin Univ., Madison. Dept. of Statistics.
CONSTRUCTION OF β-CONTENT TOLERANCE REGIONS AT CONFIDENCE LEVEL γ FOR LARGE SAMPLES FROM THE k-VARIATE NORMAL DISTRIBUTION
Irwin Guttman. Apr. 1968. 40 p refs. Supported in part by Wis. Alumni Res. Found.
(Contract DA-31-124-ARO(D)-462)
(TR-128; AD-671013)

The paper extends the use of an approximation due to Wald and Wolfowitz (1946) to cases of $k = \text{or} > 2$. TAB

N68-31080# Houston Univ., Tex. Dept. of Mechanical Engineering.
HYDRODYNAMIC MODULATION, AN EXPERIMENTAL STUDY OF THE MODULATION PHENOMENON FOR UNDERWATER APPLICATION
W. S. Mitchell and D. Muster. Jun. 1968. 170 p refs
(Contract Nonr-4492(01))
(TR-10; AD-671070)

Fluid modulation is that process in which pressure fluctuations are produced in a flowing fluid by a local time-dependent variation in the area constraining the flow. This process is involved in the production of human speech. A theoretical and experimental investigation was made of this phenomenon to ascertain its applicability to the problem of underwater communication. The theoretical portion of the text contains an analog study of sirens and other modulators based on vacuum-tube analyses. Mechanical devices were constructed which produced acoustic signals of from 20 Hz to 2 kHz in water by modulating a liquid flow. The experimental results showed that hydrodynamic modulation can be developed further as a practical means for producing acoustical signals underwater. Author (TAB)

N68-31165 Rensselaer Polytechnic Inst., Troy, N. Y.
DRAG REDUCTION CAUSED BY HIGH POLYMER SOLUTION INJECTED IN WATER FLOWING AROUND CYLINDRICAL BODIES
Clifford Nelson Baronet (Ph.D. Thesis) 1966. 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00. Order No. 67-9272

Models consisting of cylindrical bodies with spherical ends were suspended coaxially within straight tubes in which water was flowing. The drag on each model was measured with sufficiently sensitive dynamometers designed and built for the purpose. Also in order to perform the experiments a suitable recirculatory water tunnel of 450 liters per minute capacity was designed and built. To study the drag reducing effects of the high polymer solutions, a technique was developed for introducing these into the mainstream of the flow. Pressure and velocity distributions were experimentally determined. Data are shown in the form of curves and it is demonstrated that quite large drag reductions result from the use of very dilute solutions of high polymers. Dissert. Abstr.

N68-31169# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
AN EXTENDED USE OF THE HYDROGEN BUBBLE TECHNIQUE FOR HIGHER VELOCITIES AND ROTATING PASSAGES
E. Lennemann and J. H. G. Howard. Jan. 1968. 32 p refs
(TN-5) CFSTI: HC $3.00/MF $0.65

The use of the hydrogen bubble technique can be extended for flow velocities up to 9 ft./sec. and Re-numbers of about 7.5×10^5. The extended use requires special electrodes, shaped for high bubble densities. The different electrode materials and the manufacturing techniques as well as a solid state pulsing circuit with a high power handling capacity are discussed. Different successful photographic arrangements are described where a special consideration is given to the application of the hydrogen bubble technique in rotating systems. The accuracy of marking streamlines by hydrogen bubbles and their fluctuation response in high velocity flows is estimated by calculating the transient function and the locus plot from the equation of motion. Author

N68-31196 Rochester Univ., N. Y.
MICRORHEOLOGICAL STUDY OF THE FLOW BEHAVIOR OF THIXOTROPIC SUSPENSIONS
Ming Chia Chuang (Ph.D. Thesis) 1967. 186 p
Available from Univ. Microfilms: HC $8.60/MF $3.00. Order No. 67-13617

A critical review of the literature on thixotropic flow behavior is presented to extend a theory based on the assumption of spheroidal aggregates in the shear flow. The maximum-viscous force on a particle in the surface of an aggregate was calculated by approximating the real velocity field by a two-dimensional field for a monodisperse suspension. The results of this calculation were then applied to a polydisperse suspension and combined with Weymann's calculation of the aggregate size distribution. This led to the flow behavior equivalent to that of a Bingham body. An explicit relation between the cohesive interparticle force and the macroscopic Bingham yield stress τ_0 was obtained. Opacity measurements as a function of concentration, time, shear rate, and aggregate size distribution were performed with a newly designed optical viscometer. The experimental results for very high shear rates show that single scattering theory can explain the behavior of the bentonite suspensions in the range of $0 \approx 3\%$ weight concentration. Dissert. Abstr.

N68-31224# Alabama Univ., University. Mechanical Engineering Dept.
A STUDY OF VISCOUS EFFECTS IN SEPARATED COMPRESSIBLE FLOW
Santiago D. Ximenez (Ph.D. Thesis) 1968. 100 p refs. Jointly sponsored by ESRO, NAS-NRC, ARMY and Comm. Natl. de Invest. del Espacio. CFSTI: HC $3.00/MF $0.65

In this dissertation a set of nonlinear differential equations for the separated flow is developed and a method of solution is presented. The present method is similar to the Crocco and Lees technique. The main difference is that in the present analysis the magnitude of the angles relative to the flow are considered significant and, therefore, the trigonometric functions have not been linearized. This permits the application of these equations to several flow configurations where the angles are definitely appreciable, such as the turbulent flow over a rearward facing step. The initial conditions to the set of equations are characterized by the parameters of the boundary layer upstream of the separated flow. In order to obtain the values of these parameters a study is made of both laminar and turbulent compressible boundary layers. For turbulent flow, in particular, a technique is developed to evaluate the velocity profiles. This technique gives results that correlates very closely with the available experimental data. For the purpose of illustration the set of nonlinear equations is used to analyze the flow over a rearward facing step. Values for the mixing coefficient are determined by applying both the nonlinear and the linearized equations to the results of available experimental data. The values obtained using the developed technique are similar to those for completely laminar flow (small angles), but are smaller than those of the linearized theory for turbulent flow (appreciable angles). Author (ESRO)

N68-31236# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE THERMAL INSTABILITY OF FLUID LAYERS HEATED FROM BELOW: EQUATIONS OF MOTION AND BOUNDARY CONDITIONS
K. Keen and W. McIlroy. Jun. 1968. 34 p refs
(Contract N00014-67-C-0443)
(RM-416; AD-670752)

In the investigation of the interaction of a submerged disturbance with an unstably stratified fluid, it was necessary to formulate the governing equations and boundary conditions controlling the behavior of an unstable layer. This formulation was done in a manner so as to allow for expansion to multiple layers and for the introduction of a hydrodynamic disturbance. The memorandum presents an analysis of conditions required for instability, and develops the differential equations and boundary conditions using a normal mode treatment similar to that in Chandrasekhars text. A more detailed examination of the interfacial deflection and the significance of surface tension was included in the section dealing with the boundary conditions. The differential equations and boundary conditions are summarized in a table. Author (TAB)

N68-31242 University of Southern Calif., Los Angeles.
THE HODOGRAPH EQUATIONS FOR ROTATIONAL FLOWS AND THE SUPERSONIC BLUNT-BODY PROBLEM
Elliot Paul Framan (Ph.D. Thesis) 1967 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-13022

The objective of this thesis is to establish an analytical framework for the study of inviscid, rotational, compressible flows in the hodograph plane; including a formulation and study of the boundary-value problem for a supersonic plane flow past a flat plate at normal incidence, and an extension of the transonic small disturbance equations to rotational flow. The system of equations of motion in the hodograph plane, which is hitherto derived for isentropic irrotational flow, is generalized for isoenergetic rotational flow. The characteristics and the compatibility equations of the resultant non-quasilinear (bilinear) system are obtained and the applicability of the characteristic methods to the non-quasilinear system in the supersonic region is demonstrated. The particular boundary-value problem of a flat plate at normal incidence to a supersonic stream is of special interest, not only because of the presence of a sonic corner, but that the boundaries in the elliptic and the related hyperbolic region are prior known in the hodograph plane. Dissert. Abstr.

N68-31257 Columbia Univ., New York.
A METHOD FOR THE MEASUREMENT OF BINARY GAS DIFFUSIVITIES
Albert Carl Frost (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-14045

High temperature diffusion coefficients for various helium-hydrocarbon systems were measured by an unsteady state technique incorporating a diffusion cell. In this thesis the mathematical model was based on a uniform purge gas concentration over the top of the cell. Such a mathematical boundary condition became a physical reality through an extensive development of various purge gas mixing devices. The simplest of these, consisting of six tangential inlet purge gas injectors, was incorporated into a precision made stainless steel diffusion cell. In order to reduce the experimental errors associated with the diffusivity measurement, an error analysis was made on the mathematical model. Diffusivities for intermediate concentration ranges were then obtained for the systems, helium-methane, helium-ethane, helium-propane, helium-butane, helium-ethylene, helium-propylene, and helium-1-butene at temperatures ranging from room temperature to 500°C. Dissert. Abstr.

N68-31270 Pennsylvania Univ., Philadelphia.
CALCULATIONS OF EXPANDING SHOCK WAVES AND LATE-STAGE EQUIVALENCE
Shih Lien Huang (Ph.D. Thesis) 1967 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-12755

A numerical scheme of the method of characteristics, the Hartree scheme, is developed to calculate the flow field of the expansion of a high pressure sphere into atmosphere. The accuracy of this scheme in solving one dimensional fluid problems is evaluated by applying it to the blast wave problem for which the exact solution can readily be calculated to a high degree of accuracy. It is shown that this method is very accurate, involving errors of less than 1%. In calculating the expanding sphere, two rather challenging problems, namely, the initial singularity and the formation of a second shock, are successfully solved through special techniques. Based on accurate detailed numerical calculations by the Hartree scheme, it is shown that "late-stage equivalence" exists in the expansion of high pressure spheres into atmosphere, provided the initial total energy in each of the spheres is held constant. Late-stage equivalence is assumed to exist if the peak pressure distribution for different expanding spheres are the same for long times. Dissert. Abstr.

N68-31295*# Techtran Corp., Glen Burnie, Md.
APPROXIMATE METHOD FOR CALCULATING A TURBULENT BOUNDARY LAYER IN THE PRESENCE OF A POSITIVE PRESSURE GRADIENT [PRIBLIZHENNYY METOD RASCHETA TURBULENTNOGO POGRANICHNOGO SLOYA PRI POLOZHITEL'NOM GRADIYENTE DAVLENIYA]
A. N. Antonov and Ye. N. Bondarev Washington NASA Aug. 1968 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhanika Zhidkosti i Gaza (USSR), no. 1, 1968 p 64–66
(Contract NASw-1695)
(NASA-TT-F-11873) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Proposed is uniparametric integral method for calculating a turbulent boundary layer in the presence of a positive pressure gradient which makes it possible to calculate the friction, heat flow, and thickness of the layer both in front of the break-away point and in some zone behind the break-away point. Author

N68-31331# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
DYNAMIC INTERACTION BETWEEN STRUCTURES AND BILINEAR FLUIDS
Hans H. Bleich and Ivan S. Sandler Apr. 1968 178 p refs
(Contract Nonr-266(86))
(CU-1-68-ONR-266(86)-CE; AD-670627)

As a mathematical model of fluids in which cavitation may occur, wave propagation in bilinear fluids is investigated. The principal difficulty is the determination of the a priori unknown and moving boundaries between the two stages of the fluid. A characteristic approach is used to study one-dimensional problems. Even in such relatively simple situations a considerable variety of cases may occur and a lengthy analysis is required. The paper emphasizes the non-trivial questions of uniqueness and existence of solutions for the bilinear model. The procedure developed is applied to a typical example. Author (TAB)

N68-31378# Texas Univ., Austin.
TWO-PHASE FLOW IN SPRAY COOLERS Final Report, 1 Apr. 1966–31 Aug. 1967
H. A. Walls, J. P. Lamb, and J. D. Lowther Arnold AF Sta., Tenn. Arnold Eng. Develop. Center Jun. 1968 92 p refs
(Contract AF 40(600)-1167)
(AEDC-TR-68-127; AD-671118)

The problem of estimating pressure drops with typical in-line bar, spray cooler configurations is discussed. Such coolers form an important component of facilities for rocket testing at simulated altitudes. The complex nature of gas-liquid flows is first discussed. This is followed by a presentation of results of some simple experiments of air flow over a tube bank in a model spray-cooler section to determine the influence of this particular geometry on

the drag coefficient. Based upon the information in these two sections, a semi-empirical analysis of two-phase flow in coolers is then developed and some results of the method are presented. Finally, recommendations are made concerning an experimental program which would enhance the further development of prediction techniques in cooler design. Author (TAB)

N68-31398# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
SOME REMARKS ON THREE-DIMENSIONAL WAKES AND JETS
Nicholas Trentacoste and Pasquale M. Sforza Apr. 1968 25 p refs
(Contract AF 49(638)-1623)
(PIBAL-68-9; AFOSR-68-0892; AD-670517)

A succinct account of the similarities between three-dimensional wake and jet flow fields is presented. Discussion is confined to the behavior of the centerline velocity, the half-width growth, and the appearance of velocity irregularities. In addition, the most recent experimental data concerning three-dimensional wakes and jets, is included. Author (TAB)

N68-31403# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
RESPONSE PROPERTIES OF A BOSE LIQUID: CONNECTION BETWEEN SYMMETRY BREAKDOWN AND MICROSCOPIC DEFINITION OF THE SUPERFLUID DENSITY
F. de Pasquale and E. Tabet 17 May 1968 43 p refs
(ISS-68/16) CFSTI: HC $3.00/MF $0.65

The aim of this paper is to study the general response properties of a Bose liquid with condensed phase, both at $T = 0°K$ and at finite temperature. This is accomplished by exploiting the gauge invariance requirement of the current-current correlation functions $K_{\mu\nu}$ with the aid of techniques developed in previous papers. The main result obtained is an explicit microscopic construction of the superfluid density ρ_s. As an example, an approximation derived from the Bogoliubov model is explicitly worked out. Gauge and Galilei symmetry breakdowns are also discussed, showing that in an infinite volume system with long range correlations Galilei relativity principle is satisfied in a very particular way. Author

N68-31410# Missouri Univ., Rolla.
SOME ASPECTS OF DROPLET GROWTH THEORY APPLICABLE TO AITKEN NUCLEI MEASUREMENTS
J. C. Carstens and J. L. Kassner, Jr. 23 Sep. 1967 23 p refs Presented at the Intern. Atmospheric Nuclei Instr. Workshop, Lannemezan, France, 8–23 Sep. 1967
(Grant NSF GA-428)

All hierarchies of approximation exist in droplet growth theory. This paper considers the growth of a stationary drop in an atmosphere of non-condensible gas supersaturated with a vapor. The treatment is extended to drop radii smaller than a mean free path. The latter is particularly important where nucleation and droplet growth take place during an expansion and it is desired to correct the supersaturation for the effects of droplet growth. Numerical results are presented for water droplets growing in supersaturated air. When droplet radii are smaller than the mean free path, the growth law deviates from the parabolic growth law observed for larger droplets. Author

N68-31424# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF A CRITICAL BLOW-IN PARAMETER ON A POROUS PLATE [EKSPERIMENTAL'NOYE OPREDELENIYE KRITICHESKOGO PARAMETRA VDUVA NA PORISTOY PLASTINE]
A. I. Leont'yev, B. P. Mironov, and P. P. Lugovskoy 28 Jun. 1967 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 10, n. 4, 1966 p 447–451
(FTD-HT-66-666; AD-670912)

Experimental data on the determination of the critical blowing parameter on a porous plate are given. The method is based on the chemical reaction of the main stream with the fluid injected. The main stream is an acid solution and the injected fluid is an alkali solution colored by phenolphthalein. With injection flow rates below critical, a neutralization reaction takes place which results in decoloration of phenolphthalein. At critical injection flow rates, the main stream is displaced, and a clearly distinguishable film of the injected liquid appears on the plate surface. The experimental values of the critical injection parameter are in good agreement with the predicted ones obtained by the asymptotic theory of the turbulent boundary layer. Author (TAB)

N68-31489# Kyushu Univ., Fukuoka (Japan). Research Inst. for Applied Mechanics.
MEASUREMENTS OF BOUNDARY LAYERS OF SHIPS. "WAKASUGI" TESTS
Toyoji Kumai, Fukuzo Tasai, Masaki Takematsu, Masakazu Tatsuno, Hajime Amamoto et al 1 Aug. 1967 48 p refs In JAPANESE; ENGLISH summary
(REPT.-1) CFSTI: HC $3.00/MF $0.65

Techniques and equipment for measuring boundary layers of full-scale ships are considered, and sucking-disks were designed to implement such an investigation. Flow visualization is applied to the wake of a ship, and the separated flow downstream of the boundary layer is mentioned. A wooden launch used in fishery investigations was studied to obtain its velocity turbulence, intensity of turbulence, and visualization of the wake. Turbulence increased in intensity with proximity to either the hull or the stern, and the flow from the boat consisted of two rotating vortices in spiral form. The separated vortex from a turning boat flowed out obliquely near the stern, and the dead water domain was formed just behind the boat. Illustrations are included of the sucking disks, pressure tube sets, vacuum chamber, turbulence detecting probe set, and equipment for wake visualization. M.W.R.

N68-31593*# Stevens Inst. of Tech., Hoboken, N. J.
HYDRODYNAMICS OF AIRCRAFT TIRE HYDROPLANING
S. Tsakonas, C. J. Henry, and W. R. Jacobs Washington NASA Aug. 1968 46 p refs
(Contract NSR-31-003-016)
(NASA-CR-1125; REPT.-1238) CFSTI: HC $3.00/MF $0.65
CSCL 01B

An approximate theory has been developed for a study of the hydroplaning tire by considering it as a planing surface of small aspect ratio in extremely shallow water. The results of this approximation exhibit hydrodynamic behavior similar to that of hydroplaning pneumatic tires and thus indicate that the tire hydroplaning phenomenon can be described from the standpoint of inviscid hydrodynamics. The analysis furnishes families of curves which can be considered to represent, qualitatively, the start of hydroplaning and thus give qualitative guidance for avoiding the undesirable hydroplaning condition. Author

N68-31688# Naples Univ. (Italy).
SMALL PERTURBATION THEORIES FOR SINGLY REACTING MIXTURES Annual Summary Report, 15 Nov. 1964–14 Nov. 1965
L. G. Napolitano Feb. 1968 98 p refs
(Contract AF 61(052)-853)
(IA-135; AFOSR-68-1397; AD-671152)

The report presents the linear and non-linear (i.e. transonic) small perturbation theory for non-equilibrium plane flows. In particular, three different transonic regimes for a singly reacting mixture are defined and the appropriate forms of the corresponding potential

equations are derived, interpreted and discussed, especially in connection with their presumable range of uniform validity in the physical space. Seven new types of potential equations are obtained, two linear and the other non linear and of the mixed type. The formal derivation of these equations is implemented by a derivation based on physical interpretations of the contributions given to the kinetic energy and excess power balance equations by the several phenomena occurring during a dynamical evolution of a gas mixture in the presence of rate processes. Author (TAB)

N68-31750# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
SPECTRUM OF TURBULENCE AND CONCENTRATION FLUCTUATIONS WITH CHEMICAL MIXING AND REACTIONS
J. Menkes and C. M. Tchen (City Coll. of the City of New York) May 1968 28 p refs
(Contract DAHC15-67-C-0011)
(P-407; AD-670737)

A method of cascade decomposition of eddies is applied to the study of mixing processes with chemical reactions. The eddy viscosity and eddy diffusivity are derived as functions of the rate of reaction. The spectral laws of turbulence and the concentrations are calculated for various mixing processes and reactions. Author (TAB)

N68-31812# Institute for Defense Analyses, Arlington, Va.
BURGER'S EQUATION: GENERALIZATIONS AND SOLUTIONS
Kenneth M. Case May 1968 15 p
(Contract DAHC15-67-C-0011)
(P-402; AD-670738)

To understand turbulence and to evaluate approximate procedures for dealing with the Navier-Stokes equations it has been helpful to have had a simple model equation due to Burger. Among other properties it is so simple that analytical solutions are possible. Here we look at some simple generalizations of this equation and their solutions in special cases. It should be noted that the essential point in these models is that by what is essentially the Euler trick of dealing with the Riccati equation one can reduce the problem to a linear one. Author (TAB)

N68-31829# Curtiss-Wright Corp., Wood-Ridge, N. J.
ON THE FORMATION OF LANGEVIN IONS IN WATER SUPERSATURATED AIR JETS
Ernesto Barreto [1968] 21 p refs Presented at the 4th Intern. Conf. on the Universal Aspects of Atmospheric Elec., Tokyo, May 1968
(Contract Nonr-4890(00))
(AD-670551)

The expansion of moist air through a supersonic nozzle which incorporates a copious supply of ions has been used to clarify some basic water condensation problems. The experimental arrangement used allows for the introduction of small ions into a supersaturated region in which the effects of surfaces, foreign condensation nuclei and self nucleation products can be completely excluded. The role of the ions is shown to be the stabilization of preformed but thermodynamically unstable water clusters thus supporting heterophase nucleation theories. After nucleation, condensation proceeds further to produce charged particles with a final size corresponding to that of large atmospheric or Langevin ions. The large number densities obtained and the high flow used suggest an attractive new method to be used in actual cloud seeding experiments. The interaction between electrostatic and thermodynamic energy in the nozzle has been used to determine from experimental data an order of magnitude for the minimum size of charged condensation nuclei. Author (TAB)

N68-31863# Naval Ordnance Lab., White Oak, Md.
SOME PROPERTIES OF SIMILARITY SOLUTIONS IN CLASSICAL HYDRODYNAMICS
A. G. Mackie Apr. 1968 32 p refs
(NOLTR-68-55; AD-670498)

An investigation was made of the properties of solutions of problems in classical hydrodynamics in which the space variables x, y, z and the time t occur in the combination x/t to the nth power, y/t to the nth power, z/t to the nth power. Of particular interest are the convected rays which are the curves composed, at time t, of particles of fluid initially occupying straight lines through the origin. In one class of free surface problems convected rays are seen to be the characteristic curves on the free surface. Further, when n = 1, it is shown that arc length is conserved on them and also that they are convex to the fluid in a certain sense. Apart from the new results obtained, a number of existing results which have appeared in the literature in connection with isolated problems are unified and generalized. Author (TAB)

N68-31947*# Scripta Technica, Inc., Washington, D. C.
CALCULATION OF A HYPERSONIC VISCOUS GAS FLOW AROUND A SPHERE NEAR THE STAGNATION LINE [RASCHET GIPERZVUKOVOGO VYAZKOGO OBTEKANIYA SFERY VBLIZI LINII TORMOZHENIYA]
B. M. Pavlov NASA Aug. 1968 17 p refs Transl. into ENGLISH from the book "Vychistlitel'yye Metody i Programmirovaniye, Chislennyye Metody v Gazovoy Dinamike" Moscow, Moscow State Univ., no. 7, 1967 p 68–82
(Contract NASw-1694)
(NASA-TT-F-11642) CFSTI: HC$3.00/MF$0.65 CSCL 20D

A steady hypersonic flow of a viscous heat-conducting compressible gas is considered on the basis of Navier–Stokes equations written in spherical polar coordinates. It is assumed that the gas is perfect and monatomic and that its volume viscosity is equal to zero, while the viscosity and heat-conductivity coefficients are proportional to the square root of the absolute temperature T. An approximate local self-similar solution is used, which makes it possible to obtain flow characteristics in the stagnation line region. A nonstationary system obtained by using an explicit difference scheme is integrated numerically in the region from the undisturbed flow down to the body and passing through the shock-wave zone. As a result, the structures of the shock layer and shock wave are determined. The results are presented of a numerical calculation of flow past a thermally insulated sphere M_∞ = 10, γ = 5/3, Pr = 3/4, with Re = 50, 100, 500, and 1000 characterizing the transition from a rarefied to a dense gas with gradual formation of a thin shock wave. Author

N68-31960*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
NONCAVITATING AND CAVITATING PERFORMANCE OF TWO LOW-AREA-RATIO WATER JET PUMPS WITH THROAT LENGTHS OF 5.66 DIAMETERS
Nelson L. Sanger Washington Aug. 1968 34 p refs
(NASA-TN-D-4759) CFSTI: HC$3.00/MF$0.65 CSCL 13K

Performance of two jet pumps was determined over a range of spacings of the nozzle exit from the throat entrance of 0 to 2.9 throat diameters. Maximum measured efficiencies of 31.3 and 37.0 percent were achieved for nozzle- to throat-area ratios of 0.088 and 0.197, respectively. These efficiencies were improvements over those obtained for previously investigated jet pumps with throat lengths of 7.25 diameters. A simple one-dimensional analysis predicted noncavitating performance within 2 percent at the best-efficiency conditions. The point of total headrise deterioration due to cavitation was predicted with reasonable accuracy by each of two related parameters. Author

N68-31998*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL FLOW FIELD INVESTIGATIONS NEAR THE SHARP LEADING EDGE OF A COOLED FLAT PLATE IN A HYPERVELOCITY, LOW DENSITY FLOW [EXPERIMENTELLE STROMUNGSFELDUNTERSUCHUNGEN NAHE DER SCHARFEN VORDERKANTE EINER GEKUHLTEN, EBENEN PLATTE IN EINER HYPERSONISCHEN STROMUNG NIEDRIGER DICHTE]
M. Becker Aug. 1968 27 p refs Transl. into ENGLISH from the WGLR Meeting Rept. of the Tech. Comm. on Aerodyn.-Hypersound Aerodyn., Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany) Jul. 1967 p 125–156
(NASA-TT-F-11717) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The flow field near the sharp loading edge of the cooled flat plate as manifested in different zones of hypersonic low-density flow is discussed. The parameter of viscous interaction is of particular importance. A classification into zones is derived from available research. Author

N68-32089# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
INTERACTION OF FLUID MOTION Scientific Report, 1 Jan.–31 Dec. 1967
William O. Criminale, Jr. 31 Dec. 1967 10 p refs
(Contract AF 49(638)-1656)
(AFOSR-68-1268; AD-670528)

A comprehensive review of the research on the interaction of fluid motion is presented. The work was divided into five problem areas: (1) Formation and development of wakes, (2) Heterogeneous fluid, (3) Response of turbulence flow, (4) Boundary layer response, (5) Homogeneous turbulence theory. A chronological bibliography is given of the papers (seminar delivered), papers submitted or published, a book, and reports in preparation. Author (TAB)

N68-32092*# Ohio State Univ. Research Foundation, Stillwater.
BOUNDARY LAYER STUDIES IN AN ARC-HEATED TUNNEL Final Report, May 1, 1965–Oct. 31, 1967
Stuart L. Petrie 29 Apr. 1968 60 p refs
(Grant NGR-36-008-032)
(NASA-CR-96152; Rept.-5) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Experimental and theoretical studies of the laminar boundary layer in the nozzle of an arc-heated wind tunnel are reported. Measurements were conducted with air as the effluent, with stagnation enthalpies from 2000 to 6000 Btu/lb at stagnation pressures near 1 atm. The data were obtained under conditions such that the boundary layer composed a major portion of the flow field. Boundary layer thicknesses and detailed velocity and temperature profiles were obtained with an electron beam and various probes. Theoretical analyses for predicting thickness distributions and boundary layer profiles were examined for applicability in high-enthalpy nozzle flows. Comparison of the theoretical and experimental boundary layer profiles shows that the temperature profiles are very sensitive to the technique of computation. Flat plate theories were found to greatly overestimate the peak temperature in the boundary layer. Transverse curvature effects were found to have a minor influence on the profiles. Good agreement of the experimental profiles with those computed with the locally similar form of the boundary layer equations was obtained when the proper value for the pressure gradient parameter was employed. Author

N68-32178# Kyushu Univ., Fukuoka (Japan). Research Inst. for Applied Mechanics.
MEASUREMENTS OF BOUNDARY LAYERS OF SHIPS, "NANSEI MARU" TESTS
Toyoji Kumai, Fuzuzo Tasai, Masaki Takematsu, Masakazu Tatsuno, Hajime Amamoto et al 2 Aug. 1967 55 p refs In JAPANESE; ENGLISH summary
(Rept.-2) CFSTI: HC $3.00/MF $0.65

Boundary layers of ships were measured for velocity profiles, turbulence, and wake by attaching to the cruising ship hull two suckling disks equipped with the necessary measuring instruments. Results show that the vortex separated from the hull was responsible for velocity profile distortions. The turbulence in the boundary layer intensified as the hull was approached and grow thicker downstream towards the stern. Wake visualization experiments discovered that the flow separated from the ship surface running straight consisted of two vortices extending with the general flow and rotating in opposite directions to each other in spiral forms; a dead water region was observed immediately behind the stern. G.G.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-30918 Colorado Univ., Boulder.
INFRARED RADIATIVE TRANSFER IN THE UPPER STRATOSPHERE AND MESOSPHERE
William Richard Kuhn (Ph.D. Thesis) 1966 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-10058

The infrared heat sources and sinks in the upper stratosphere and mesosphere are investigated. The flux divergence of radiation is computed for the 15 micron band of carbon dioxide, the 9.6 micron band of ozone, and the 6.3 and 80 micron bands of water vapor. The quasirandom band model and the appropriate line broadening mechanisms are used to compute theoretical transmission profiles. A Planck source function is used for the ozone and water vapor bands, since they significantly influence the flux divergence only up to a height of about 70 km, and up to this height the population densities of these bands are given by the Boltzmann distribution (thermodynamic equilibrium). The distributions of the infrared rates of temperature change are also calculated as a function of latitude for summer and winter. The implications of the distribution of infrared radiative sources and sinks for the general circulation of the stratosphere and mesosphere are briefly discussed. Dissert. Abstr.

N68-30920 California Univ., San Diego.
OCEANIC ELECTRIC CURRENTS, GEOMAGNETIC VARIATIONS AND THE DEEP ELECTRICAL CONDUCTIVITY STRUCTURE OF THE OCEAN-CONTINENT TRANSITION OF CENTRAL CALIFORNIA
Jean Henri Filloux (Ph.D. Thesis) 1967 187 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-14242

The variations of electromagnetic field components along a line across central California have been examined in the frequency range .125 to 4 cph by means of an array of stations extending from 320 km inland to 630 km offshore. The three components of the magnetic variations were recored at six land positions. Simultaneously, records of the oceanic electric field in a direction approximately parallel to the coast were obtained at three stations located as far as 150 km offshore by using self-contained recorders installed on the sea floor. A record of the two horizontal components of the electric field was provided by a station 630 km offshore, together with a record of the horizontal magnetic variations to the magnetic east. At one station, 110 km offshore, the total magnetic variations at the sea surface were also recorded using a towed proton magnetometer. Dissert. Abstr.

N68-30926 Rice Univ., Houston, Tex.
VECTOR MEASUREMENT OF THE MID-LATITUDE SQ IONOSPHERIC CURRENT SYSTEM
Paul Andrew Cloutier (Ph.D. Thesis) 1967 138 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-13063

The results of two rocket-borne vector magnetometer experiments are presented and evaluated. These experiments were designed to detect and measure the vector direction of the magnetic field associated with an ionospheric current system. The experimental techniques are discussed, and the flight instrumentation is described. Vector information obtained on the second flight showed the current direction to be mainly westward, in agreement with the direction expected from the ground magnetic measurements. The vector measurements also indicated a highly disordered magnetic field within the current layer. Using electron density altitude profiles obtained by ground ionosondes, the tensor conductivity components are evaluated. These calcualtions indicate that the position and intensity of the current layer were controlled by an enhancement of the electron density in sporadic E layers observed during flight. It is shown that variations in enhancement may be responsible for the variety of current structures reported by this and other investigators. Dissert. Abstr.

N68-30958 Columbia Univ., New York.
MAGNETIC ANOMALIES IN THE PACIFIC AND OCEAN FLOOR SPREADING
Walter Clarkson Pitman, III (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-14079

Over 50,000 miles of total intensity magnetic anomaly profiles from the South Pacific have been studied. The magnetic anomalies form a pattern that is parallel to and bilaterally symmetric about the Pacific-Antarctic Ridge. The pattern extends from the base of the New Zealand shelf at 180° west longitude to 90° west longitude near the west coast of South America, and between 40° south latitude and 60° south latitude. The pattern is often offset by fracture zones. The pattern found in the South Pacific is correlated in detail with that found in the North Pacific between latitudes 25° north and 52° north and from the west coast of North America to approximately 165° west. The geographical extent of the pattern and its consistent relationship to the mid-oceanic ridge system strongly support the concept of ocean floor spreading and periodic polarity reversals of the earth's magnetic field as the causal processes. From the crustal model constructed to reproduce the anomaly pattern, a history of magnetic reversals to the late Cretaceous may be postulated. Dissert. Abstr.

N68-31046 Illinois Univ., Urbana.
E-REGION IONIZATION AND THERMAL STRUCTURE
Puttaveeriah Paramasivaiah (Ph.D. Thesis) 1967 225 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-11895

The Chapman theory accounts fairly satisfactorily for the gross ionization structure in the E-region, but fails to account for the detailed behavior. Two methods are described to evaluate the ionization rate and recombination coefficients for the E-region. In the first method, generalized continuity equations, applicable for any day in the year, are set up for nitric oxide and molecular oxygen ions. These are solved on the analog computer to obtain the dissociative recombination coefficients for the molecular oxygen and nitric oxide ions. In the second method, the electron production rate during sunrise at any given altitude is deduced from a knowledge of the observed electron density profile in the E-region at some time close to local noon when photoequilibrium condition can be presumed to exist. An exact analytical solution of the continuity equation is obtained for the computed electron production rate function during sunrise. An experimental standing wave analysis, designed to measure electron density from rocket signal strength in the E-region, is outlined. This method is found to be useful in the study of Sporadic E. The experimental techniques currently used for the exploration of the ionosphere are discussed. Dissert. Abstr.

N68-31078# National Committee for Space Research, Haifa (Israel).
IONOSPHERIC RESEARCH USING SATELLITES
Jonathan Mass et al 29 Feb. 1968 33 p refs *Its* Sci. Rept. No. 3
(Contract AF 61(052)-837)
(AFCRL-68-0314; AD-670585)

Results of measurements of electron content, of ionospheric slab thickness and of scintillations from three low latitude stations are presented. The three stations are Nairobi (Kenya), Kingston (Jamaica), and Haifa (Israel). Measurements were made at the three stations, of the Faraday polarization rotation of radio signals from the ionospheric beacon satellites S-66 and BE-C, during the period March-June 1965. The results show similar diurnal variations of electron content for the three stations, with a ratio of daytime maximum to predawn minimum of 8-10. Large variation in daytime values of electron content appear between Nairobi and Haifa, indicating large latitudinal gradients. The daytime values at Kingston and Haifa differ by about 25%. There are similar results of slab thickness and of scintillation occurrence at Haifa and Kingston, while at Nairobi the slab thickness values are lower and there is an increase in the percentage of scintillation occurrence, in comparison to the other two stations. Results of electron content for the declining phase of the solar cycle for mid-latitude stations show a marked dependence on the sunspot number. Results of electron content at Haifa for the increasing phase of the sunspot cycle show similar relationship between electron content and sunspot number. Author (TAB)

N68-31084 Oklahoma Univ., Norman.
EFFECTS OF LARGE-SCALE SUBSIDENCE ON CELLULAR CONVECTION IN THE ATMOSPHERE: A NUMERICAL EXPERIMENT
Stanley Louis Barnes (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-11995

Numerical solutions are obtained for a set of linearized, variable-coefficient, differential equations governing convective motions in a shallow, stably-stratified layer continuously heated at its base. The boundary conditions include a rigid, conducting upper boundary and an open lower boundary with a constant excess temperature. The basic state is subsiding and has a temperature distribution which varies with height. With assumed sinusoidal horizontal perturbations of excess temperature, the development and energetics of convective cells are studied for wave lengths 1 to 100 km, both with and without subsidence. Solutions up to twelve hours are obtained. The effects of horizontal and vertical eddy diffusion, Coriolis, and radiation are included. The model approximates conditions in the capping stable layer associated with the weak, cellular convective cloud patterns of scale 10 to 100 km observed from meteorological satellites. Dissert. Abstr.

N68-31088 Illinois Univ., Urbana.
RESPONSE OF IONOSPHERIC ELECTRON DENSITY TO A CHANGE OF ELECTRON TEMPERATURE
Thomas Ronald Pound (Ph.D. Thesis) 1967 140 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-11904

The F2 region of the ionosphere is investigated using a transport-production spatial model. In this model the F2 region is assumed to be lossless, while the lossy lower region of the ionosphere is represented by an electron sink. A temporal model is used in which the transition from day to night is represented by a step function change of the production rate of ionization and

electron temperature. The main emphasis of the work is to study the effect of a change of electron temperature for ionospheric conditions near a sunspot minimum. The seasonal anomaly in both the midday f_0F2 and electron content near sunspot minimum is investigated by including not only a flux of ionization out of the summer ionosphere and into the winter ionosphere, but also by including a seasonal change of electron temperature. Reasonable agreement is found between the theory and experiment.
Dissert Abstr.

N68-31105# Boeing Scientific Research Labs., Seattle, Wash.
MAGNETOSPHERIC PARAMETERS DETERMINED FROM STRUCTURED MICROPULSATIONS
J. F. Kenney, H. B. Kraflich, and H. B. Liemohn Mar. 1968 55 p
(D1-82-0691; AD-671076)

The structured elements in Pc 1 and Pi 1 events display characteristics of multihop and halfhop ULF whistlers respectively. Analysis of these events which is carried out for different magnetic field and plasma distribution models yields useful information about the source and propagation of these micropulsations as well as information about the magnetospheric plasma distribution. The Pc 1 propagation zone is centered about 75 degrees geomagnetic latitude on the sunlit hemisphere, and about 65 degrees on the dark hemisphere. Equatorial plasma densities are in general agreement with those determined from VLF whistler analysis and satellite observations. Evidence for spikes and steep gradients in the plasma density is presented. The region for propagation of structured Pi 1 elements is located between seven and thirteen earth radii at solar magnetospheric longitudes of approximately 135 degrees. The difference between the structured Pc 1 and Pi 1 elements is discussed in terms of hypothetical sources and of the magnetospheric wave amplification by trapped particles in the ion-cyclotron resonance interaction.
Author (TAB)

N68-31128# Michigan Univ., Ann Arbor. Dept. of Geography
A DIGITAL TERRAIN LIBRARY
Waldo R. Tobler and Charles M. Davis Mar. 1968 28 p refs
(Contract DA-31-124-ARO(D)-456)
(Rept.-08055-1-T; AROD-6504-1-EN; AD-671039)

The need for a digital terrain library of modest size for exploratory investigations has remained. The current effort is an attempt in this direction and was undertaken as a more or less isolated sub-project of a larger study. In keeping with these general objectives, the size of each described portion of terrain is relatively small. The specific parcels were chosen to represent distinct physiographic types by selection from the U.S. Geological Survey set of 100 topographic maps illustrating physiographic features in the United States. No attempt at analysis of the resulting data are reported in this document.
Author (TAB)

N68-31172 Florida Univ., Gainesville.
ENERGY DEGRADATION OF ELECTRONS IN ATMOSPHERIC GASES
Richard Stanley Stolarski (Ph.D. Thesis) 1966 174 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13164

The problem of the loss of energy of electrons in atmospheric gases is studied with emphasis placed upon the low energy secondaries produced. A phenomenological analysis of electron impact cross sections on atomic oxygen, molecular nitrogen and molecular oxygen is presented. The energy loss of electrons in these gases is then considered and the spectra of the secondaries and tertiaries is considered in detail. The results are then applied to estimate auroral and dayglow intensities.
Dissert. Abstr.

N68-31180# Illinois Univ., Urbana.
HORIZON CONTROLLED ANALYTICAL AEROTRIANGULATION
S. Weissman Nov. 1967 179 p refs *ITS* Photogrammetry Ser. No. 13
(Grant NSF GK-776)
(PB-178030)

The horizon camera is one of the currently available auxiliary instruments which provide the values of the mapping camera tilt components (phi and omega) at the moment of exposure. A new method deducing the absolute values of these orientation parameters from the horizon pictures has been established. If definite points can be observed on the horizon pictures, the swing (kappa) can also be determined. However, an investigation is conducted here to analyze the effect of kappa on the determination of phi and omega in case that no definite points are observable.
USGRDR

N68-31202# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
THE MACROSTRUCTURE OF GEOMAGNETIC BAYS
Gordon Rostoker 26 Apr. 1968 34 p refs Sponsored by the NAS-NRC
(Rept.-68-08) CFSTI: HC $3.00/MF $0.65

Evidence is presented which suggests that geomagnetic bay disturbances occur in two stages. The onset of each stage is accompanied by a pi 2 micropulsation; the fact that a pi 2 occurs almost synchronously over the Earth's surface allows the onset of this micropulsation to be used to define the onset of each stage of a bay. The time lag between the onsets of the two stages ranges from about 10 – 30 minutes. The delay between the two stages is suggested to be the time required for the transfer of information from the front of the magnetosphere to the region of reconnection in the magnetotail. The recognition of the first stage of a bay as a precursor can facilitate high resolution studies of auroral phenomena.
Author (ESRO)

N68-31238# Ohio State Univ. Research Foundation, Columbus.
MODEL COMPUTATIONS FOR DIFFERENT SOLUTIONS OF THE GEODETIC BOUNDARY-VALUE PROBLEM
Karl-Rudolf Koch Feb. 1968 43 p refs
(Contract AF 19(628)-5701)
(AFCRL-68-0164; Rept.-102; SR-18; AD-671127)

To solve the boundary-value problem of physical geodesy, the perturbing potential is usually expressed by the potential of a simple layer. By introducing this expression into the boundary condition, Molodenskys basic integral equation is obtained; the solution of which enables us to compute the perturbing potential and its first derivative. To check the results of this method, Greens formula can be used. After transforming this formula and its derivative by a method, due to Molodensky, a linear integral equation for the disturbing potential is obtained. With the solutions of this integral equation, the first derivative of the disturbing potential can be computed from the transformed derivative of Greens formula. For a model consisting of a cone on a plane the basic integral equation and the integral equation of Greens formula are solved by successive approximation with a computer. The solution of the basic integral equation is also obtained by Molodenskys method. These three solutions are compared for different inclination angles of the surface of the cone. The results agree very well for small inclination angles, but the approximations don't converge for greater inclination angles. The reason has to be sought in the errors of numerical integration, by which the integration over the surface of the model is solved.
Author (TAB)

N68-31306 Clark Univ., Worcester, Mass.
AN ANALYSIS OF THE MAP AS AN INFORMATION SYSTEM DISPLAY
John Ellis Dornbach (Ph.D. Thesis) 1967 203 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-13539

An analysis of recent improvements in providing a more efficient cockpit display of information to be used by a pilot and in providing better aeronautical charts for rapid perception of cartographic information suggested that similar applications could be made to other cartographic materials. It also showed that since the map purportedly had a language of its own, it could be "translated" by the cartographer through design, so that the information the user or student was to receive would be transmitted to him accurately, quickly, and concisely. This dissertation concludes therefore, that contrary to most cartographic and geographic practice of today, the map need not, in fact, should not be as difficult to comprehend as a foreign language and that the cartographer is most responsible for adhering to standards and conventions which perpetuate the concept that maps can be useful only after their language has been learned and understood. Dissert. Abstr.

N68-31310# Max-Planck-Institut für Aeronomie, Lindau über Northeim (West Germany). Inst. für Ionosphärenphysik.
THEORETICAL DESCRIPTION OF THE BEHAVIOR OF THE NOCTURNAL F-LAYER [THEORETISCHE BESCHREIBUNG DES VERHALTENS DER NACHTLICHEN F-SCHICHT]
Peter Stubbe 1966 47 p refs In GERMAN
(REPT.-26/1966) CFSTI: HC $3.00/MF $0.65

An attempt is made to explain the behavior of nocturnal F-layer with the aim to decide which of the possible five explanations is best and to gain some knowledge on certain parameters of the ionosphere and the high atmosphere. An IBM 7040 computer program has been worked out to resolve in a numerical way the non-stationary continuity equation taking into account the movement of neutral gas. It is shown that the concentration coefficient of the F-layer explicitly depends on temperature and that the behavior of the nocturnal F-layer can be explained by electron losses, ambipolar diffusion and plasma drift. ESRO

N68-31325*# Bendix Corp., South Bend, Ind. Energy Controls Div.
LUNAR MODULE (LM) SOIL MECHANICS STUDY, VOLUME 2 Final Report
1 May 1968 42 p refs
(Contract NAS9-5759)
(NASA-CR-92215; AM-68-1, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Descriptions of the 12 basic soils used in the Lunar Module (LM) soil mechanics study are presented; and pertinent chemical analysis, physical properties, and handling methods used to maintain repeatable test bed preparation for each soil are included. Procedures for determination of the sonic modulus of the test soils are detailed, and direct shear test data are presented. The full-scale LM footpad drag test facility design is detailed, and subscale vacuum/atmospheric impact tester and subgravity simulator experimental apparatus is described. M.W.R.

N68-31337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF ELECTRON COOLING RATES IN THE MIDLATITUDE AND AURORAL ZONE THERMOSPHERE
L. H. Brace, H. G. Mayr, and G. R. Carignan Jun. 1968 34 p refs
(NASA-TM-X-63291; X-621-68-211) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Two day-night pairs of Thermosphere Probe rockets, launched at Wallops Island, Virginia in March of 1965 and at Churchill, Manitoba in November of 1965, have provided altitude profiles of electron temperature and concentration at midday and midnight. Altitude profiles on N_2 measured on the same four flights have in addition provided neutral gas temperature profiles. These data are employed to calculate electron cooling rate profiles, and these in turn are interpreted in terms of ionospheric heat sources. The daytime electron heat source for the F-region, at both middle latitudes ($L = 2.9$) and in the auroral zone ($L \approx 8$), appears consistent with solar ultraviolet heating. The nighttime F-region however appears to be heated by downward conduction from the protonosphere at middle latitudes and by particle heating in the auroral zone. The source of electron heating for the E-region both day and night and at both locations cannot be explained by direct solar heating. This may be produced by neutral winds, electric currents, an unknown chemical reaction or, as Walker has suggested, selective heating of the electrons by excited N_2 having lifetimes in the E-region of the order of a day. Author

N68-31351*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FINE STRUCTURE IN THE ENERGY SPECTRUM OF LOW ENERGY AURORAL ELECTRONS
D. S. Evans Jul. 1968 21 p refs
(NASA-TM-X-63298; X-612-68-291) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Several auroral electron data collection events and measurement techniques are reviewed. Data on low energy auroral particles are analyzed. The resulting electron energy spectra are characterized as having structure with peaks. Two types of explanation are proposed to account for this phenomenon; it is due to an energy selection process, or it is a direct consequence of the energizing process. Interpretation and discussion of the collected data in the framework of these propositions strongly indicate that electrostatic fields have played a role in the acceleration process although alternatives cannot be eliminated. Several plots of the electron energy spectra are included. D.H.S.

N68-31390*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THEORETICAL SPECTRAL SCATTERING OF ICE CLOUDS IN THE NEAR-INFRARED
James E. Hansen and Howard Cheyney Aug. 1968 30 p refs
(NASA-TM-X-61036) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The spectral reflectivity of clouds of ice spheres is calculated for the near infrared wavelength region ($1\mu < \lambda < 4\mu$) for comparison with laboratory observations of ice clouds. The laboratory cloud particles were highly nonspherical ice crystals, however, it is shown that the major feature of the theoretical spectrum are in close agreement with the observations when spheres of equal volume are employed in the radiative transfer problem. The results provide some support for the contention that randomly oriented nonspherical particles may be replaced by equivalent spheres for calculations of intensities. The reflectivities are shown to be sensitive to the particle size, especially the reflectivity minima near 1.5 and 2.0 μ. Changes by a factor of two in the particle size cause significant variations in the major reflectivity features; this verifies that spectral reflectivity measurements can be of considerable value for cloud identification. The agreement of the theoretical and experimental spectra also indicates that it should be possible to obtain meaningful conclusions from infrared reflectivity measurements of planetary atmospheres, such as the observations which have been made on the atmosphere of Venus. Author

N68-31412# International Business Machines Corp., Gaithersburg, Md.
EXPERIMENTAL SIGNAL PROCESSING SYSTEM Quarterly Technical Report, 1 May–31 Jul. 1967
Bedford, Mass. AFSC, Electron. Systems Div. Aug. 1967 192 p refs
(Contract F19628-67-C-0198; ARPA Order 800)
(ESD-TR-68-149; QTR-3; AD-670868)

The report identifies the effort expended to provide the hardware and software in support of research and development

directed toward the study of seismic signal processing. It also delineates work tasks planned for the next quarter. This document presents detailed information related to machine configurations, time delay correlation, event location accuracy, optimum processing, fast Fourier transform, array design, steering delay library, magnitude estimation, and travel time characterization. Author (TAB)

N68-31414* State Univ. of Iowa, Iowa City. Physics and Astronomy Dept.
THE LOW FREQUENCY CUTOFF OF ELF EMISSIONS
Donald A. Gurnett and Thomas B. Burns May 1968 34 p refs
(Grant NGR-16-001-043; Contract Nonr-1509(06))
(NASA-CR-95954; REPT.-68-28) CFSTI: $3.00 CSCL 04A

ELF and VLF radio noises observed by satellites in the ionosphere often have a very sharp lower cutoff frequency near the proton gyrofrequency. This paper summarizes the experimentally observed characteristics of this low frequency cutoff and proposes an explanation for the cutoff based on the reflection of downward propagation, extraordinary mode, waves near the two-ion cutoff frequency between the proton and helium gyrofrequencies. This explanation, if correct, provides the first direct evidence that chorus and ELF hiss emissions are generated at high altitudes (above 3000 km) and not near the base of the ionosphere. Ground-based observations of 700 Hz noise bands near the auroral zone, previously attributable to proton cyclotron radiation at low altitudes in the ionosphere can now be explained by this reflection mechanism. Other possibly related effects (such as multiple ELF noise bands and the reflection of whistlers at the two-ion cutoff frequency) are discussed. Author

N68-31448# British Columbia Univ., Vancouver. Inst. of Earth and Planetary Sciences.
THE TRANSMISSION OF GEOMAGNETIC DISTURBANCES Final Report, 1 Feb. 1960–14 May 1968
John A. Jacobs May 1968 51 p refs
(Contract Nonr-3116(00))
(SR-18; AD-670625)

The research has been mainly concerned with a theoretical investigation of geomagnetic disturbances. The chief interest has been geomagnetic micropulsations with periods from a few minutes down to a fraction of a second. Particular attention has been paid to those of irregular type and to hydromagnetic emissions (regular pulsations with periods around one second). A permanent field station has been in operation for more than 5 years - from June 1962 to December 1967. Additional field stations were maintained at Suffield Experimental Station, Alberta; Great Whale River, Quebec; Byrd Station, Antarctica - these are still in operation. In addition a number of field operations were carried out to determine the effect on micropulsations of local geology and proximity of the observing station to the sea. Large period magnetic disturbances have been used to carry out a programme of geomagnetic depth sounding - to determine possible structures and electrical conductivities. Author (TAB)

N68-31456# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
THEORETICAL AND EXPERIMENTAL STUDIES OF MECHANICAL PROPERTIES OF ROCK Final Report, 1 Oct. 1963–30 Jun. 1968
William F. Brace 1 May 1968 36 p refs Supported in part by ARPA
(Contract AF 19(628)-3298)
(AFCRL-68-0261; AD-670603)

The effects of the geologic environment, exclusive of high temperature, have been studied for a number of mechanical properties of rocks. The influence of confining pressure, and strain rates and high pore pressure have been studied for brittle fracture, elastic properties, electrical resistivity, thermal conductivity, permeability and sliding friction. The rocks studied were typical crustal varieties, ranging in composition from granite to peridotite. We have applied our results to shallow focus earthquakes and to the mechanics of faulting in the earth. Author (TAB)

N68-31514 Danish Meteorological Inst., Charlottenlund.
OCEANOGRAPHICAL OBSERVATIONS FROM DANISH LIGHT-VESSELS AND COASTAL STATIONS [OCEANOGRAFISKE OBSERVATIONER FRA DANSKE FRYSKIBE OG KYSTSTATIONER]
1967 171 p

Oceanographic observations made by Danish light vessels and coastal stations during 1967 are tabulated; and observations of the direction, height, and period of waves as well as synoptic meteorological data are included. Current, temperature, and salinity measurements were made every three hours during each day. M.W.R.

N68-31550# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
RELATIONSHIP BETWEEN THE ONSET OF A GEOMAGNETIC BAY AND THE CONFIGURATION OF THE INTERPLANETARY MAGNETIC FIELD
Gordon Rostoker 26 Apr. 1968 18 p refs Sponsored by the NAS-NRC
(Rept.-68-09) CFSTI: HC$3.00/MF$0.65

It has been suggested that the direction of the North-South component of the interplanetary magnetic field B_I influences the state of geomagnetic activity, and that geomagnetic bays are more likely to occur when the field in the ecliptic plane B_E is directed away from the sun. A complete bay sample available has been analyzed with the aim of studying the configuration of B_I and B_E and of relating this to the onset of the bays. It is suggested that the strength and direction of the interplanetary magnetic field and the magnitude of the solar wind velocity contribute in part to the generation of bay and storm activity. ESRO

N68-31553*# Volt Technical Corp., Washington, D. C.
RELATIONSHIP BETWEEN THE DIRECTION OF THE INTERPLANETARY MAGNETIC FIELD AND STEADY OSCILLATION CONDITIONS
Ov. Bolshakova and V. A. Troitskaya 15 Aug. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), v. 180, no. 2, 1968 p 343–346
(Contract NAS5-12487)
(NASA-CR-96139; ST-GM-IS-10735) CFSTI: HC $3.00/MF $0.65 CSCL 08N

This work establishes that the direction of the interplanetary magnetic field in the ecliptic plane is the determining parameter of excitation or attenuation mechanisms of steady oscillations of the various Pc groups. The Pc amplitude modulation is determined by the change in field direction, the former decreasing to zero when the latter is perpendicular to the line Sun–Earth. The data obtained allowed the authors to establish for the first time the nature of the agent responsible for the sudden onset and vanishing of Pc oscillations. Author

N68-31574*# Scripta Technica, Inc., Washington, D. C.
COMPOSITION OF TRACE MINERAL INCLUSIONS IN CASSITERITE, FROM POINT X-RAY SPECTRAL ANALYSIS [SOSTAV MIKROMINERALOV, VKLYUCHENNYKH V KASSITERITE, PO DANNYM TOCHECHNOGO RENTGENOSPEKTRAL'NOGO ANALIZA]

Ye. I. Dolomanova, V. V. Lider, and V. N. Rozhanskiy NASA Jul. 1968 10 p refs Transl. into ENGLISH from Zap. Vses. Mineralog. Obshchestva (Moscow), v. 95, no. 2, 1966 p 214–221
(Contract NASw-1694)
(NASA-TT-F-11752) CFSTI: HC $3.00/MF $0.65 CSCL 08D

X-ray microanalysis of black cassiterite from the Etyka tin deposit of Transbaykalia revealed the presence of trace amounts of, Nb, Ta, Fe, Mn, W, Ti, Zr, Sc, Al, Si, As, Ga, V, Be, Pb, Cu, Ca, Mg and In. Author

N68-31630# Avco Corp., Lowell, Mass. Space Systems Div.
ANTARCTIC RESEARCH AND DATA ANALYSIS. THE ANTARCTIC IONOSPHERE. PART A: SURVEY AND BASIC INFORMATION
Rudolf Penndorf Apr. 1968 95 p refs
(Contract NSF C-515)
(AVSSD-0053-68-CR, Pt. A; SR-28; PB-178241) CFSTI: HC $3.00/MF $0.65

A general survey of the Antarctic ionosphere is given. It is based on our own investigation of data collected since the beginning of the IGY, supplemented extensively by results published by other investigators. The first part contains the necessary basic information, followed by a survey of the climate of the ionosphere, i.e. the average conditions, and finally the dynamics of the ionosphere, i.e. the disturbed conditions. In this first part a general description of the upper atmosphere is given; the methods of exploring the ionosphere are briefly outlined; the station parameters, equipment, and data are listed. Samples of data and an extensive number of graphical representations are given. Author (USGRDR)

N68-31644# Atmospheric Turbulence and Diffusion Lab., Oak Ridge, Tenn. Inst. for Environmental Res.
NOTES ON THE THEORETICAL BASIS OF THE EQUATIONS FOR THE ATMOSPHERE'S SURFACE LAYER
Nov. 1967 54 p refs
(IERTM-ATDL-7; PB-177327) CFSTI: HC $3.00/MF $0.65

A meeting was held on July 7–8, 1966, at the Atmospheric Turbulence and Diffusion Laboratory, ESSA, in Oak Ridge, Tennessee, to discuss the theoretical basis of the equations for the mean wind and temperature profiles in the atmosphere's surface layer. USGRDR

N68-31649# International Geophysical Year World Data Center A, Washington, D. C.
CATALOGUE OF DATA IN WORLD DATA CENTER A, 1 JULY 1957–30 JUNE 1966
Oct. 1966 151 p refs

This Catalogue of Data lists all the airglow, aurora, ionosphere, cosmic ray, geomagnetism and solar activity data received by WDC-A since 1 July 1957 and supersedes all previous WDC-A catalogues in these disciplines. Author

N68-31673# Raytheon Co., Burlington, Mass. Spencer Lab.
AN EXPERIMENTAL TEST OF THE ACOUSTIC-GRAVITY WAVE INTERPRETATION OF TRAVELLING IONOSPHERIC DISTURBANCES Interim Scientific Report, 1 Apr. 1967–31 Mar. 1968
George D. Thome and Pendyala B. Rao May 1968 51 p refs
(Contract DA-01-021-14482(z); ARPA Order 982)
(AD-671061)

The report presents the results of simultaneous HF Doppler and UHF incoherent backscatter measurements of the travelling ionospheric disturbances observed at Arecibo (P.R.) during the summer of 1967. One of the prime objectives in conducting this series of experiments involving 3 spaced phase path sounders and the backscatter radar is to examine the gravity wave interpretation of the large scale travelling disturbances. The analysis of the observations is based upon three distinct techniques: (1) Cross-correlation analysis of the HF Doppler records for an accurate estimate of the wave velocity, (2) HF ray tracing for demonstrating the self-consistency of the HF and the incoherent backscatter data, and (3) the coupling of acoustic gravity waves to the ionospheric plasma. It is concluded from the results of the analysis that the large scale travelling ionospheric disturbances are truly a manifestation of the acoustic-gravity waves. Finally, some aspects of the analysis which will be refined in the next phase of the study are also outlined. Author (TAB)

N68-31700# Interdepartmental Committee for Atmospheric Sciences, Washington, D. C.
NATIONAL ATMOSPHERIC SCIENCES PROGRAM: FISCAL YEAR 1969
Jan. 1968 63 p
(ICAS-12; PB-178190) CFSTI: HC $3.00/MF $0.65

The Federal Weather Modification Program proposed to accelerate progress in three significant areas: precipitation modification, hail suppression and inadvertent modification. National plans for warm fog research, for cold fog dissipation, and for hail suppression research are continuing under development and when completed may still provide new guidance for FY 1969 activities. Encouraging results are also continuing from Project Skyfire, the lightning suppression research program of the Forest Service, and it is planned to expand over 50% for FY 1969. The growing interest and involvement of social scientists will enable increasingly more progress to be made in the identification and solution of the current and potential legal, social, and economic problems associated with the expanding activities in weather modification. Author (USGRDR)

N68-31717# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
ENERGY BUDGET OF THE STRATOSPHERE DURING 1965
Merwin E. Richards 20 Dec. 1967 186 p refs
(Contract AT(30-1)-2241)
(MIT-2241-38; Rept.-21) CFSTI: HC $3.00/MF $0.65

A monthly statistical analysis was made of the effects of large-scale horizontal eddy transport processes on the zonal momentum, heat and energy budgets for three layers of the 1965 stratosphere. Geostrophic wind components were computed from IQSY data at 100, 50, 30, and 10 mb for use in calculating the statistical quantities used in the analysis. It was found that temporal and spatial variances and covariances computed from monthly means of temperature and geostrophic wind components give meaningful results when used in the computation of momentum, heat and energy balances. Monthly meridional distributions of eddy transports and energy conversions show large latitudinal and height variations. They also indicate a physically reasonable compatibility with month-to-month changes in zonal mean values of temperature, zonal wind and geopotential. It was further determined that in the winter, the eddies in the middle stratosphere convert a self-contained source of zonal available potential energy into eddy available potential energy. It is speculated that further conversion of this energy eventuates in its availability as a significant source for the mean zonal motions. Author (NSA)

N68-31726# Naval Oceanographic Office, Washington, D. C. Geodetic Studies Branch.
INVESTIGATIONS IN DETERMINING ASTRONOMIC LATITUDES AND THEIR COMPUTER PROGRAMS
Larry B. Bourquin Apr. 1968 193 p refs
(IR-68-21; AD-671183)

Several methods of collecting and reducing stellar data to obtain astronomic latitudes have been investigated and are

summarized in this report. Considered herein are various stellar coordinate systems, observing procedures, refraction models, and instrumentation. The investigations are based upon 1264 stellar observations made by the author during the summer of 1966. Comments and conclusions are found at the end of each chapter. Widely accepted methods are in some cases substantiated and in others are refuted. Computer programs and tabulations of observational data may be found in the Appendix. Author (TAB)

N68-31728# Adelaide Univ. (Australia). Dept. of Physics.
OBSERVATIONS OF CEN XR-2, SCO XR-1 AND TERRESTIAL X-RAYS
J. R. Harries and R. J. Francey (Tasmania Univ.) May 1968 23 p refs Submitted for Publication
(ADP-50) CFSTI: HC$3.00/MF$0.65

Two identical X-ray experiments were flown on Skylark rockets from Woomera, Australia, during April 1967. Sco XR-1 and Cen XR-2 were observed on both flights. The Cen XR-2 flux was 1.5×10^{-7} ergs cm^{-2} sec^{-1} (2 to 8 keV) when first observed but had decreased to 1.0×10^{-7} ergs cm^{-2} sec^{-2} and had become softer by the second flight. An X-ray flux from the earth was observed and found to be due to solar X-rays reflected in the atmosphere. Author

N68-31751# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
EFFECTS OF PLANETARY TOPOGRAPHY ON THE DEEP SEA CIRCULATION, WITH AN APPLICATION TO THE NORTH ATLANTIC
Pierre Welander Jun. 1968 51 p refs
(Contract Nonr-4010(01); Grant E-22-50-68(G))
(TR-25(ONR); TR-28(WB-ESSA); AD-670617)

A discussion is given of the deep circulation in an ocean of variable depth H. The circulation is driven by a vertical velocity prescribed at a horizontal interface. The model is an extension of the one given by Stommel and Arons (1960). Assuming that the non-geostrophic regime is confined to a western boundary current, a general picture of the transport field can be given. In the case where a source of deep water exists near the northern boundary and a general upwelling through the interface occurs elsewhere, a deep southward boundary current at the western wall is obtained, as shown already by Stommel. When a meridional midbasin ridge is introduced, part of this boundary current is replaced by a ridge current, a similar deep current running along the eastern slope of the ridge. As these two currents flow south the ridge current leaks water to the west. Thereby the boundary current amplifies, the ridge current decays. At a certain latitude the ridge current vanishes, and further south it is replaced by a northward current. Author (TAB)

N68-31840# Florida State Univ., Tallahassee. Sedimentological Research Lab.
THE MINERALOGY AND GEOCHEMISTRY OF MANGANESE MODULES FROM THE SOUTHERN OCEAN
Maurice A. Meylan (M.S. Thesis) Feb. 1968 184 p refs *Its* Contrib. 22
(Grant NSF GA-40)
(PB-178242) CFSTI: HC$3.00/MF$0.65

This study depicts the relationships between the mineralogy and the elemental chemistry of the ferromanganese nodules of the Southern Ocean, and correlates the physical, mineralogical, and chemical properties of the concretions with such environmental parameters as depth, proximity to volcanism, and distance from continental areas. Possible changes in nodule characteristics with time are also investigated, using samples found at various depths of burial in sediment cores. Author (USGRDR)

N68-31843# Sandia Corp., Albuquerque, N. Mex. Scientific Translation Service.
MEASUREMENT OF THE NEUTRON FLUX DURING THE SOLAR ECLIPSE OF NOVEMBER 12, 1966 [MEDICION DEL FLUSO DE NEUTRONES DURANTE EL ECLIPSE SOLAR DEL 12 DE NOVIEMBRE DE 1966]
A. A. Cicchini and A. N. Simionati de Fritz 4 Apr. 1968 20 p refs Transl. into ENGLISH of a paper presented at the intern. Solar Eclipse Symp., Brazil, 5–9 Feb. 1968
(SC-T-68-1516) CFSTI: HC$3.00/MF$0.65

Measurements are reported of the neutron flux with energies between 0.1 and 10 Mev in the so-called South American anomaly before, during, and after the solar eclipse. The measurements were carried out by means of balloons which reached the maximum altitude of 23,000 m and of an airplane at a height of 9,600 m. No changes were recorded in the mean absorption length or in the atmospheric thickness corresponding to the maximum neutron count during and after the eclipse; the values obtained agreed with those of other researchers at a similar geomagnetic latitude. A decrease of approximately 7% was recorded in the flux of neutrons measured with the detector whose sensitivity extends up to energies of 10 Mev. Author (NSA)

N68-31848# National Research Council of Canada, Ottawa (Ontario).
DETERMINATION OF EXTINCTION IN THE EARTH'S ATMOSPHERE AT WAVELENGTHS OF 20 AND 3.2 CM [BESTIMMUNG DER EXTINKTION IN DER ERDATMOSPHAERE BEI 20 UND 3.2 CM WELLENLAENGE]
F. Fuerstenberg 1967 21 p refs Transl. into ENGLISH from Z. Astrophys. (GERMANY), v. 49, 1960 p 42–60
(NRC-TT-1302) CFSTI: HC$3.00/MF$0.65

As part of a general program of absolute measurements of radiation from extraterrestrial sources, the atmospheric damping is determined experimentally for wavelengths of 20 cm and 3.2 cm by measurements of solar radiation in the vicinity of the horizon, and the results are examined for regularities. The increase of extinction with the zenith angle conforms to Bemporad's equation for the optical region. Extended series of tests gave mean values of 0.072 db for $\lambda = 20$ cm and 0.084 db for $\lambda = 3.2$ cm for extinction over the whole distance through the atmosphere at perpendicular incidence. Author

N68-31876# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
STRATOSPHERIC CIRCULATION RESPONSE TO A SOLAR ECLIPSE
Harold N. Ballard, Jagir S. Randhawa, and Willis L. Webb Mar. 1968 65 p refs
(ECOM-5189; AD-670933)

Late in 1965 the National Science Foundation (NSF) issued an invitation to United States scientists interested in the study of the 12 November 1966 solar eclipse to prepare experiment proposals so that NSF could provide effective coordination of the total eclipse study effort. The very important diurnal temperature variations associated with atmospheric tidal motions which were discovered in 1964 through use of sensitive synoptic rocket systems had raised questions relative to the response of the stratopause to perturbations of shorter period than the diurnal variations. A proposal was generated which provided a mechanism through which the necessary coordination was achieved and the experiment accomplished. Principal contributors to the experiment were the Atmospheric Sciences Laboratory, Comision Nacional de Investigaciones Espaciales (CNIE) of Argentina and the National Aeronautics and Space Administration. Personnel of CNIE moved the Chemical, Argentina, meteorological rocket station to Tartagal, Argentina to obtain observations in the path of the total eclipse. Data were obtained

from each of the 12 rocket soundings under somewhat adverse field conditions. The data serves to point the way toward further experiments of this nature and was particularly informative in that it provided synoptic and diurnal data from a new location in the Southern Hemisphere for use in the global synoptic meteorological rocket network exploration of the upper atmosphere. Author (TAB)

N68-31878# Environmental Science Services Administration, Boulder, Colo. Research Labs.
ELECTROMAGNETIC INDUCTION IN A SMALL CONDUCTING SPHERE ABOVE A RESISTIVE HALF-SPACE
James R. Wait 22 Apr. 1968 22 p refs
(Contract PRO-CP-67-823)
(AFCRL-68-0242; SR-41; AD-670602)

The limitations of detection of a small metallic sphere by the electromagnetic induction method are discussed. Particular attention is given to the masking effect of a conductive half-space located beneath the scatterer. The results indicate that a dual frequency operation should provide the required discrimination. Author (TAB)

N68-31888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIURNAL VARIATION OF THE ION TEMPERATURE
K. K. Mahajan Jun. 1968 19 p refs
(NASA-TM-X-63297; X-621-68-11) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Results on the diurnal variation of the ion temperature, obtained from the Thomson scatter spectra, in the height range 250-475 km are presented. At 250 km where the ion temperature (T_i) is expected to be nearly equal to the neutral temperature (T_n), T_i is generally observed to show diurnal maximum at 16 hr L. T. and diurnal minimum at 4 hr L. T., with no appreciable change in these times with solar activity. The average day to night T_i ratio at 250 km is found to be 1.45. These results are in apparent conflict with the satellite drag analysis in which T_n is found to have a diurnal maximum at 14 hr L.T. and day to night temperature ratio around 1.30. At 475 km where T_i is significantly above T_n, the diurnal behavior of T_i is observed to be different on different days. The day-to-day and hour-to-hour variations in T_i at this height are found to be due to the changes in the electron density and electron temperature and seem consistent in terms of an energy budget that includes heating of the ion gas by the hotter thermal electrons and cooling by the neutral atmosphere. Author

N68-31894# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE POTENTIAL OF OBSERVATION OF THE OCEANS FROM SPACECRAFT
Dec. 1967 179 p refs Sponsored by the Natl. Council on Marine Resources and Eng. Develop.
(PB-177726) CFSTI: HC $3.00/MF $0.65

Contents: Space oceanographic achievements; User requirements; Space ocean technology; Evaluation; Space oceanographic systems; Economic contributions of space oceanography; and, Space oceanographic prognosis. USGRDR

N68-32006# Polish Academy of Sciences, Warsaw.
DETERMINATION OF THE COORDINATES OF THE EARTH'S CENTER OF MASS
C. Popovici *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 75–79 refs (See N68-32000 19-30)

In the method proposed, the coordinates of the earth's center of mass are determined on the basis of the geocentric coordinates of a single satellite in relation to the reference ellipsoid to which are reduced the positions of the tracking stations that participated in determination of the satellite's coordinates through simultaneous or semisimultaneous observations. Author

N68-32006# Polish Academy of Sciences, Warsaw.
GRAVIMETRIC DETERMINATION OF THE GEOCENTRIC COORDINATES OF SATELLITE-TRACKING STATIONS
K. Arnold *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 81–85 refs (See N68-32000 19-30)

A method is outlined for convenient determination of the geocentric coordinates of satellite-tracking stations on the basis of data on the gravimetric deflections of the plumb line. Author

N68-32009# Polish Academy of Sciences, Warsaw.
DETERMINATION OF ATMOSPHERIC DENSITY FROM VARIATIONS IN THE ORBITAL ELEMENTS OF ARTIFICIAL SATELLITES OF THE EARTH
M. Ill *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 101–108 refs (See N68-32000 19-30)

The method advanced by H. Philipps for determining the atmospheric density is used to derive simple formulas for determining the atmospheric density and its variations. The calculation can be carried out on the basis of simultaneous visual measurements such as are made under the INTEROBS program. Author

N68-32026# Rand Corp., Santa Monica, Calif.
THE WESTWARD DRIFT AND GEOMAGNETIC SECULAR CHANGE
E. H. Vestine and Anne B. Kahle Sep. 1967 19 p refs Submitted for publication
(P-3667)

Short-term fluctuations in the length of the day on the order of a decade are discussed in relation to fluctuations in westward drift of the outer part of the earth's core. Decreases in the earth's rotation rate noted near 1910 and 1965 are shown to be correlated with decreases in westward drift of the earth's magnetic eccentric dipole, which probably originates fairly deep within the earth's core. If the outer two-hundred-km thickness of the core moves approximately as does the eccentric dipole field, the changes in angular momentum implied for this part can explain the observed changes in the length of the astronomical second, on the basis of conservation of angular momentum. Other estimates of westward drift in the core based on higher-degree harmonic terms give a lower westward drift, and also seem to show less precision in the estimates of flow in the core. These discrepancies are unexplained. Author

N68-32080# Oak Ridge National Lab., Tenn.
SOLAR NEUTRON TRANSPORT IN THE EARTH'S ATMOSPHERE
R. G. Alsmiller, Jr. and R. T. Boughner [1967] 31 p refs
(NASA Order R-104(1); Contract W-7405-ENG-26)
(NASA-CR-96100; ORNL-TM-2194) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The neutron flux per unit energy induced in the Earth's atmosphere by solar neutrons has been calculated as a function of atmospheric depth for depths of less than 300 g/cm^2 (30,000 ft). The calculated flux is compared with estimates of the cosmic-ray neutron flux per unit energy, and it is found that for many flares the solar neutron flux per unit energy is sufficiently above the cosmic-ray neutron flux per unit energy to produce a measurable effect at both balloon and aircraft altitudes. Author (NSA)

N68-32095# California Univ., Livermore. Lawrence Radiation Lab.
TIDES IN A NUMERICAL MODEL OF THE ATOMSPHERE
John W. Hardy 18 Apr. 1968 49 p ref
(Contract W-7405-ENG-48)
(UCRL-50368) CFSTI: HC $3.00/MF $0.65

Results from investigation into tidal effects in the LAM code, a numerical model of the atmosphere, are reported. General qualitative agreement with the atmosphere was found. This agreemant included the existence of traveling waves and standing waves whose components corresponding to the first three wave numbers had the correct order of magnitude. Some quantitative agreement was also found, for instance, the traveling wave component of the semi-diurnal component has the proper phase. Statistical significance of all results is discussed. Statistical arguments are presented showing that there is a dependence of amplitude and phase of the traveling wave components of the tide upon time. Author (NSA)

N68-32128# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY AND SPACE, NO. 185
9 Aug. 1968 150 p refs
(JPRS-46149) CFSTI: HC $3.00/MF $0.65

This semimonthly publication consists of material gathered from recent publications of the Sino-Soviet Bloc countries, presented in the form of abstracts, summaries and occasional full translations of articles. Complete bibliographic information accompanies each article. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-30914 Cornell Univ., Ithaca, N. Y.
TURBOROTOR INSTABILITY-DYNAMIC UNBALANCE, GYROSCOPIC, AND VARIABLE-SPEED EFFECTS WITH FINITE-LENGTH, CAVITATED, FLUID-FILM BEARINGS
Robert Henry Badgley, Jr. (Ph.D. Thesis) 1967 201 p
Available from Univ. Microfilms: HC $9.25/MF $3.00 Order No. 67-12329

The rigid-body dynamics of a general class of rotors supported in plain, cylindrical, cavitated, fluid-film journal bearings are investigated numerically by Runge-Kutta extrapolation techniques. Expressions for journal force due to the fluid-film are developed for the short-bearing, long-bearing, and finite-length-bearing approximate solutions to the Reynolds equation. Stability of plane motion is investigated for each solution under the assumption of light initial impact. The long-bearing solution appears to be most conservative, that is it predicts the onset of instability at lower angular velocity ratios than the other solutions, for static eccentricity ratios between 0 and 0.5. Dissert. Abstr.

N68-30989 California Univ., San Diego.
A CRYOGENIC GRAVIMETER
William Arthur Prothero, Jr. (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13444

A gravimeter with potentially very low noise and drift rate operating at 4.2°K and utilizing the phenomenon of superconductivity is designed and constructed. The mechanical configuration consists of a one-inch diameter hollow superconducting ball supported by a 2.25 inch diameter Helmholtz pair of superconducting coils wound with niobium wire. A force gradient of 100 to 300 dynes/cm is obtained at the required support force by varying the current ratio in the two coils. Position sensing is provided both by a capacitance measuring network and a field detector. Changes in the force on the ball due to external effects such as changes in gravitational acceleration then cause a capacitance bridge signal but no field detector signal. Changes in force on the ball due to magnetic support field changes cause a signal in both devices, providing an internal measurement of the drift rate and noise. Dissert. Abstr.

N68-31019# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DIGITAL MASS SPECTROGRAPHIC PLATE READER
R. W. Bonham, J. O. Humphries, and J. M. Shakoski, ed. 13 May 1968 13 p refs
(Contract AT(29-2)-656)
(GEPP-32; R68ND9) CFSTI: HC $3.00/MF $0.65

An integrating mass spectrographic plate reader that was developed to reduce the time required for spark source analyses is described. This unit, used in conjunction with a standard scanning densitometer, features digital readout and a background compensation circuit. The use of this digital plate reader in spark source mass spectrographic analyses provides a definite improvement in precision and reliability, minimizes operator errors, and reduces evaluation time from four to five hours to about one hour. Author (NSA)

N68-31108# National Inst. for Metallurgy, Johannesburg (South Africa).
DETEMINATION OF BERYLLIUM BY IRRADIATION WITH GAMMA RAYS Final Report
A. Knight, J. I. W. Watterson, E-A. Uken, and P. K. Faure 22 Mar. 1967 21 p refs
(NIM-152; C.77/66; RR-152)

A simple instrument that has been built for the determination of beryllium by the well-known photoneutron method is described. Samples are irradiated with gamma rays from an antimony-124 source, and the resultant photoneutrons are detected by boron trifluoride neutron counters. Results are given for samples and standards that contain up to 0.6 per cent BeO. Author (NSA)

N68-31113# Aerospace Corp., El Segundo, Calif.
THE RADIALLY VIBRATING ROTATING GRAVITATIONAL GRADIENT SENSOR
V. Chobotov Jun. 1968 38 p refs
(Contract F04695-67-C-0158)
(TR-0158(3307-01)-18; SAMSO-TR-68-207; AD-670571)

The concept and operating characteristics of a radially vibrating gravitational gradient sensor are presented. The sensor is a tuned mechanical oscillator that responds to gravity-gradient forces when it is rotated in a stationary gravitational field. Because of the inherent dynamic magnification resulting from resonant or near resonant operation of the sensor it obtains high sensitivity and can potentially be used as an accurate attitude control sensor, an orbital altimeter, or a navigation aid in a variety of satellite applications. Author (TAB)

N68-31118# Weather Bureau, Sterling, Va. Test and Evaluation Lab.
TEST AND EVALUATION OF THE MORTARBOARD PSYCHROMETER Final Report
Walter E. Hoehne and Roger A. Tucker Jan. 1968 25 p refs
(WBTM-T&EL-3; PB-177689)

The mortarboard psychrometer was developed by the Southern Forest Fire Laboratory as a simple, accurate, inexpensive means of obtaining wet-and dry-bulb temperature readings to be used in estimating fine fuel moisture. A number of commercially available psychrometers were tested by the Southern Forest Fire Laboratory; each produced accurate readings when carefully operated, but they were either too expensive, too fragile, too hard to operate, or required ventilated shelters. These undesirable features led to the development and testing of the mortarboard psychrometer.
Author (USGRDR)

N68-31199# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France). Div. Mathématiques et traitement.
MAGNETOMETERS AND SOLAR SENSORS AS ATTITUDE INDICATORS FOR ROCKETS AND SATELLITES [RESTITUTION D'ATTITUDE DE FUSEES ET SATELLITES PAR MAGNETOMETRES ET SENSEUR SOLAIRE]
L. Bergeron 4 Apr. 1966 22 p In FRENCH Presented at the School on the Technol. of Space Expt. Sponsored by the CNES
CFSTI: HC$3.00/MF$0.65

Computation is indicated to restore attitude of a spacecraft from the knowledge of the value of the magnetic field along three rectangular directions and from the direction of the sun. ESRO

N68-31214# Waterloo Univ. (Ontario). Mechanical Engineering Dept.
MANOMETERS FOR USE IN ROTATING SYSTEMS
G. M. Bragg Jul. 1968 13 p refs
(TN-9) CFSTI: HC$3.00/MF$0.65

Two techniques are presented for measuring pressure differentials in a rotating reference frame with the aid of a stroboscope. The techniques may be used in combination and are simpler mechanically than those previously used. A complete analysis is presented for both measurement calibration and system design.
Author

N68-31225# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
HIGH PERFORMANCE γ SPECTROMETRY USING Ge-Li DETECTORS [SPECTROMETRIE γ A HAUTE PERFORMANCE A L'AIDE DE DETECTEURS Ge-Li]
Jean-Pierre Brethon, Gérard Libe, Guy Detourne, Jean Legrand, and Jean Pierre Boulanger Jan. 1968 16 p refs In FRENCH; ENGLISH summary
(CEA-R-3405) CFSTI: HC$3.00/MF$0.65

This report describes a high resolution gamma spectrometer design which uses Ge-Li detectors, a cooled field effect transistor preamplifier, and a spectrum stabilizer. The obtained resolution on the ^{122}keV gamma ray of the ^{57}Co is 0.96 keV, and ^{239}Pu, ^{233}Pa and ^{95}Zr + ^{95}Nb spectra are shown as an example.
Author (ESRO)

N68-31235# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
EXPOSURE-RATE DEPENDENCE OF SELECTED GAMMA DOSIMETERS
Thomas W. Crimmins, Nancy N. Gibson, Armand M. Pelletier, and John R. Jacobson Jan. 1968 25 p refs
(NDL-TR-94; AD-664758)

The experiment studied the effects of exposure rate on the response of the following gamma dosimeters: silver-activated metaphosphate glass plates and rods, lithium fluoride and manganese-activated calcium fluoride microthermoluminescent dosimeters, and cobalt-activated borosilicate glass plates. Data obtained in the exposure range of approximately 1,500 to 45,000 R at exposure rates from 5.2×10^{10} R/s to 2.2×10^{10} R/s. The results of this experiment indicate that no differences exist in the relative responses of the various dosimeters that may be attributed to exposure rate or to an interaction between exposure and exposure rate. No absolute exposure measurements were made, therefore data were analyzed on a relative basis.
Author (TAB)

N68-31237# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PRESSURE GAUGE FOR HIGH ELECTRICAL NOISE LEVEL ENVIRONMENT
W. R. Grabowsky, D. A. Durran, and T. A. Rognlien Mar. 1968 12 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-10)-9; SAMSO-TR-68-213; AD-671124)

A pressure gauge consisting of a strain gauge transducer, an infrared decoupler and an amplifier is described for the measurement of time-varying pressures in the presence of an electrical noise environment typical of capacitor discharge systems. This gauge requires fewer electronic components, and is inherently more stable and linear than a previously employed gauge that utilized rf decoupling. The gauge can be statically calibrated, has a risetime of approximately 5 microseconds, and can be compensated for electronic drift.
Author (TAB)

N68-31245# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
VARIABLE TEMPERATURE CRYOSTAT: 1.3 TO 300°K [CRYOSTAT A TEMPERATURE VARIABLE ENTRE 1,3 ET 300°K]
Pierre Roubeau and Michel Vandevyver Mar. 1968 19 p refs In FRENCH; ENGLISH summary
(CEA-R-3463) CFSTI: HC$3.00/MF$0.65

A set of two cryostats for regulating temperature between 1.3 and 300°K using forced circulation of liquid helium is described.
Author (ESRO)

N68-31252# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
NEUTRON DIFFRACTOMETER OF THE INSTITUTE FOR ATOMIC PHYSICS (BUCHAREST)
Z. Gheorghiu, N. Dutescu, D. Gelberg, and D. Bally 1968 14 p refs Submitted for publication
(IFA-FN-33)

The construction and operation of a neutron diffractometer for studying single crystals and polycrystalline powders which is mounted at one of the WWR-S reactor horizontal channels is described. The results of the resolution and intensity measurements on a Ni power sample compared with theoretical data are also given.
Author (NSA)

N68-31317# Franklin Inst., Philadelphia, Pa. Research Labs.
FEASIBILITY OF A TOROIDAL STREAM ANGULAR RATE SENSOR Final Report
George P. Wachtell Apr. 1968 33 p refs
(Contract DAAJ02-67-C-0043)
(USAAVLABS-TR-68-11; AD-671024)

It is theoretically feasible to build a toroidal stream angular rate sensor (TSARS) based on the principle that a series of vortex

rings is deflected by the Coriolis force so that the rotational velocities measured by a pair of symmetrically placed sensors are slightly different. The sensors may be the input ports of a jet type of fluid amplifier. It should be possible to detect angular rates as low as 0.05 deg/sec, with disturbance frequencies up to 10 cps. An uncertain item is the precise reproducibility of the vortices that are generated. An alternative design concept, having several advantages over the TSARS as well as the jet type of angular rate sensor, is the vortex axis jet angular rate sensor (VAJARS), in which a straight vortex is provided along the axis of a large-diameter jet. Experimental studies are recommended, with VAJARS considered to be more promising. Author (TAB)

N68-31372*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.

THE DESIGN AND BUILD OF A GAS BEARING GYROSCOPE POSSESSING HIGH G AND STERILIZATION CAPABILITY AND UTILIZING A LOW POWER GAS BEARING SPINMOTOR AND HIGH FREQUENCY PUMP Quarterly Progress Report, 1 Apr.–30 Jun. 1968

J. M. Bremer 30 Jun. 1968 14 p Prepared for JPL
(Contracts NAS7-100; JPL-951559)
(NASA-CR-95978; Rept.-20660-QR6) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Work on the design, construction, and test of a gas bearing gyroscope possessing high g and sterilization capability and utilizing a low-power gas bearing spin motor and high-frequency pump produced a preliminary gyro assembly and initial gyro test results. Steps were taken to correct several problems noted in the initial testing, and a partial assembly of the final device was produced. Author

N68-31393# Air Force Missile Development Center, Holloman AFB, N. Mex. Central Inertial Guidance Test Facility.

GYROSCOPE STANDARD GYROCOMPASSING ACCURACY TEST

Hayne A. Thompson, Jr. and Judith Keostler Dec. 1967 41 p ref
(MDC-TR-67-148; AD-670523)

The Central Inertial Guidance Test Facility (CIGTF) standard gyrocompassing accuracy test and associated data analysis procedures for single-degree-of-freedom gyros are presented. The gyrocompassing error, the error in the north direction as determined by the gyroscope, is obtained by orienting the gyro in four specific orientations and measuring the output of the gyro while in the torque-to-balance mode. This procedure is repeated 24 times for a total of 25 north determinations during which the gyro is not shut down. From these data a determination is made of the average gyrocompassing error and of the operating instability of the gyrocompassing error. This operating phase is followed by a shutdown phase consisting of 10 north determinations, each separated by a two-hour gyro shutdown and two-hour warmup. From these data the shutdown instability of the gyrocompassing error is determined. Although the test and data analysis procedures described in this report are written specifically for single-degree-of-freedom gyros, the theory can easily be applied to two-degree-of-freedom gyros. This report also contains a description of the CIGTF gyroscope laboratorys two axis automated gyrocompassing test station and a test error analysis. Author (TAB)

N68-31395# Parke Mathematical Labs., Inc., Carlisle, Mass.

TRANSIENT ANALYSIS OF TRANSDUCER ARRAYS

Charles H. Sherman and Dorothy A. Moran May 1968 43 p refs
(Contract N00140-68-C-0109)
(SR-1; AD-670804)

A method for analyzing the transient behaviour of the transducer velocities in an array of transducers is described and used to obtain results for several typical situations. The method is based on a finite difference iteration solution of the differential equations for the array. It uses results of Mangulis for the transient self acoustic loading and makes approximations for the acoustic interactions based on Rayleighs general expression for the field of a source in an infinite, rigid plane. The results obtained are for small plane arrays of small circular pistons. They show that the transient period can be considerably extended by the interactions and that effects of practical importance such as velocity overshoots often occur during the transient period. Author (TAB)

N68-31423# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROGRESS IN SCIENTIFIC PHOTOGRAPHY, VOLUME 9

A. A. Vorob'yev, V. A. Moskalev, V. N. Kologrivov, A. A. Anchurov 31 Aug. 1967 18 p refs Transl. into ENGLISH from USP. Nauchn. Fotogr. (Moscow), v. 9, 1964 p 171–172, 236–242
(FTD-HT-67-210, V. 9; AD-670915)

Contents: An X-ray source for high-speed photography of various processes; and The study of the spectrum of a detonation wave with the SP-75 spectrograph. TAB

N68-31467# American Science and Engineering, Inc., Cambridge, Mass.

REFURBISHMENT, TEST, INTEGRATION AND FIELD SUPPORT OF SCIENTIFIC INSTRUMENTS OF THE OVI-13 SATELLITE Final Report, 4 Jan. 1967–3 Apr. 1968

F. R. Paolini, G. C. Theodoridis, W. F. Welsh, and P. Zucker 10 Jun. 1968 111 p
(Contract F19628-67-C-0234)
(ASE-1929; AFCRL-68-0286; AD-670870)

The work performed included the refurbishment and calibration of two instrument sets previously fabricated. It also included the design and fabrication of three signal conditioners and the subsequent integration of the instruments into the OVI-13 spacecraft which is providing data on the energy spectra and angular distributions of trapped electrons in the magnetosphere, over a wide energy and dynamic range. The instruments refurbished and calibrated consisted of two flight space DC/DC converters, two each of an electrostatic analyzer (ESA), magnetic analyzer (e-MA), scintillation spectrometer (e-S), solid state spectrometers (p-SS1 and p-SS2), range-energy spectrometer (p-RE), geiger counter (GC) and programmable high voltage supply (PHVS). Hnadbooks of alignment and calibration data were prepared and submitted with the delivery of the instruments. Author (TAB)

N68-31474# Missouri Univ., Rolla. Cloud Physics Research Center.

THE MYTH CONCERNING THE CONDENSATION NUCLEUS COUNTERS

J. L. Kassner, Jr., J. C. Carstens, and L. B. Allen [1967] 33 p refs Presented at the Intern. Atmospheric Nuclei Instr. Workshop, Clermont Univ., France, 8–23 Sep. 1967; Sponsored by Intern. Assoc. of Meteorology and Atmospheric Phys.
(Grant NSF GA-428)

Consideration is given to certain assumptions concerning the physical processes which take place in the condensation nucleus counter which severely affect the reliability of data obtained with them. The assumption that the condensation process is so slow that negligible depletion of available vapor occurs during the expansion itself is not consistent with fact, particularly where droplet concentrations exceed 50 drops/cm^3. Since the expansion takes place on an unknown nucleus spectrum and the exact time course of the pressure expansion is not recorded, there is no way

to relate the number of nuclei condensed upon to the actual peak supersaturation achieved by the instrument. Recommendations are made to alleviate some of the problems. Author

N68-31475# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
CORRELATION TYPE TIME-OF-FLIGHT SPECTROMETER WITH MAGNETICALLY CHOPPED POLARIZED NEUTRON BEAM
L. Pal, N. Kroo, J. Gordon, P. Pellionisz, F. Szlavik, and I. Vizi 8 Apr. 1968 18 p refs
(KFKI-7/1968)

The essential features of the correlation method of time-of-flight spectroscopy are discussed. An experimental setup including monocrystal slabs, the flipper chopper, the sample, and the neutron detector is described. Measurements were carried out in order to show the efficiency of the correlation method. NSA

N68-31481# Joint Publications Research Service, Washington, D. C.
AUTOMATIC GAS ANALYZER FOR DETECTION OF MICROCONCENTRATIONS OF FREON
Kh. I. Agranov and L. V. Reyman 8 Aug. 1968 5 p refs Transl. into ENGLISH from Kholodil'n. Tekhn. (Moscow), no. 2, 1965 p 20–23
(JPRS-46143)

The design of a gas analyzer to determine the amount of Freon-12 present in the air is given. The operating characteristics of the gas analyzer is discussed based on the photo-colorimetric analytical method which makes it possible to determine the presence of Freon in a wider range of concentrations. The analyzer can be used to inspect the air-tightness of refrigerating machines both in operation and during their manufacture. B.S.D.

N68-31495# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN AMPLITUDE ANALYZER MADE WITH A SOLID ACOUSTIC DELAY LINE [AMPLITUDNYY ANALIZATOR NA TVERDOY AKUSTICHESKOY LINII ZADERZHKI]
Yu. M. Grashin, V. I. Yefremenko, K. G. Finogenov, and A. P. Tsitovich 12 Sep. 1967 19 p refs Transl. into ENGLISH from Ref. Zh. Fiz. (Lyubertsy), v. 2, 1963 p 163–172
(FTD-MT-66-132; AD-670963)

A 64-channel pulse-height analyzer using a solid delay line is described. The analyzer circuit contains several elements to extend its operating capabilities. The input unit has two amplifier channels, a coincidence circuit, and a transmission circuit, making it possible to separate and investigate time-correlated signals. The information accumulated in the memory can be picked off the screen of the monitor tube in binary or linear form, and can also be extracted channel by channel by means of a special binary-to-decimal conversion circuit. The analyzer resolution time is 1 millisecond. The analyzer is immune to interference and stable in operation. TAB

N68-31497# Finnish Meteorological Office, Helsinki.
COMPARISON OF THE FINNISH SUNSHINE RECORDER WITH THE INTERNATIONAL STANDARD INSTRUMENT
Veikko Rossi 1967 20 p refs *Its* Contrib. No. 68
CFSTI: HC $3.00/MF $0.65

A Finnish sunshine recorder was compared with an international standard instrument by measurements taken at the Jokionen observatory between 1963 and 1966; and results obtained were used to adjust the values of bright sunshine duration obtained between 1957 and 1966 and to determine the relationship between sunshine duration and cloudiness over this period. The Finnish instrument, a Fuess-type autograph equipped with heater, registered 2.9% less duration in the summertime than the Casella international instrument; while the Finnish autograph registered a considerably greater duration during the winter months. In an obstruction-free horizon, the relative sunshine duration measurement is affected by the construction of the recorder and, in particular, the support for the recording strip. M.W.R.

N68-31525*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334S Quarterly Progress Report, 1 Apr.–1 Jul. 1968
J. M. Bremer 15 Jul. 1968 14 p Prepared for JPL
(Contracts NAS7-100; JPL-951529)
(NASA-CR-96134; Rept.-20584-QR7; QPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Progress reported in the development of wide angle gas bearing gyroscopes showed that additional magnetic shielding for the gimbal was necessary. Organic and particulate contamination studies were performed and four modified gimbal and spinmotors assemblies were completed. G.G.

N68-31530# Société d'Etudes et d'Application de Vide Optique et Mecanique, Franconville (France).
TECHNICAL PROBLEMS IN FABRICATING INTERFERENTIAL FILTERS [PROBLEMES TECHNOLOGIQUES POSES PAR LA FABRICATION DES FILTRES INTERFENTIELS]
B. Saudreau *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 25–28 refs (See N68-31528 19-23)

Errors caused to photometric measurements by an interferential filter are analyzed. Physical and optical properties of SEAVOM filters are indicated. ESRO

N68-31538# Office National d'Etudes et de Recherches Aérospatiales, Paris (France).
O.N.E.R.A. INFRARED DETECTOR TEST LABORATORY [LE LABORATOIRE O.N.E.R.A. DE CARACTERISATION DES RECEPTEURS INFRAROUGES]
J. Laurent *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 99–103 (See N68-31528 19-23)

Characteristics of infrared detectors are reviewed. A brief description is given of the equipment available at O.N.E.R.A. to test such detectors. ESRO

N68-31548*# Scripta Technica, Inc., Washington, D. C.
PIEZOELECTRIC PRESSURE TRANSDUCERS. DYNAMIC CALIBRATION [CAPTEURS DE PRESSION A EFFET PIEZOELECTRIQUE. ETALONNAGE DYNAMIQUE]
F. Valentin NASA Aug. 1968 27 p refs Transl. into ENGLISH of the French Rept.
(Contract NASw-1694)
(NASA-TT-F-11813) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A description is given of an electronic apparatus that permits tracing the frequency response curves of piezoelectric transducers. The effect of their sensitivity to vibrations is investigated. Author

N68-31552*# Rocketdyne, Canoga Park, Calif.
DEVELOPMENT OF A BREADBOARD MODEL OF AN ALL-PNEUMATIC NEUTRON FLUX DETECTOR Final Report
S. E. Milleman 23 May 1968 160 p refs
(Contract NAS3-7989)
(NASA-CR-72422; R-7492) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A breadboard Model was constructed of an All-Pneumatic Neutron Flux Detector. Subassemblies of the detector consisted of a sensing element which was electrically heated to simulate neutron heating effects, a precooler, a temperature equalizer, and a fluid interaction logarithmic function generator. The detector was designed to produce a pneumatic output signal proportional to the logarithm of incident neutron flux. Performance test were made on all system subassemblies except the sensing element. Sensing element heater development tests were completed. Author

N68-31570# Atlantic Richfield Hanford Co., Richland, Wash.
AN ALPHA, BETA-GAMMA SINGLE CHASSIS SURVEY INSTRUMENT
M. L. Campbell and T. R. Garland 21 Feb. 1968 12 p ref
Presented at the Conf. on Technol. Util., Seattle
(Contract AT(45-1)-2130)
(ARH-488; CONF-680425-1) CFSTI: HC$3.00/MF$0.65

By introducing a small flow of methane into a standard air proportional poppy probe, a high efficiency, low energy beta and a much improved alpha survey instrument was developed. The methane gas poppy probe (MGP) was found to be more sensitive to all energies of beta than either of the standard survey instruments routinely used (mica window and standard GM). A factor of eighteen in surface area drastically lowers the time of survey and minimizes missing point source contamination. This modification is made on existing equipment, improving that equipment for its original purpose, and adds a very sensitive low energy beta survey probe in a single chassis, for less than a total expenditure of $50.00. Author (NSA)

N68-31601*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALIBRATIONABLE PRESSURE SWITCH (CALIPS) CHECKOUT SYSTEM LOOP ACCURACY EXPERIMENT
H. H. Watters and R. W. Nelson 17 Jul. 1968 67 p refs
(NASA-TM-X-53729) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Presented is a summary report of an experiment conducted to evaluate the accuracy capabilities of calibrationable pressure switch (CALIPS) checkout systems. It was found that if the range of the reference transducer matches that of the switch under test, if the ground A/D converter is properly aligned, and if the pneumatic ramp rate is slow enough, accuracy requirements can be met or exceeded. Author

N68-31620# Naval Research Lab., Washington, D. C.
A COMPUTER PROGRAM FOR THE QUANTITATIVE INTERPRETATION OF MASS SPECTROGRAPHIC PHOTOPLATES
Paul P. Bey and James G. Allard 8 Apr. 1968 15 p refs
(ARPA Order 418)
(NRL-6855; AD-670593)

To determine impurity concentrations in solids using mass spectographs, ion-sensitive emulsions are used. The principal problem in obtaining quantitative results from a mass spectrum recorded on a photographic plate is determining the characteristic response curve. Calculations required to determine the parameters in an empirical function which accurately represents the response curve of Ilford Q2 emulsions are programmed in FORTRAN language. The program input data consists of the impurity-ion mass, line density, and exposure; the impurity-ion concentration and the detection limit are calculated and printed as output. Author (TAB)

N68-31677# California Univ., Berkeley. Lawrence Radiation Lab.
PERFORMANCE OF A VALDRE HEATING AND TILTING STAGE IN THE SIEMENS ELECTRON MICROSCOPE
E. F. Sturcken Apr. 1968 42 p refs
(Contract W-7405-eng-48)
(UCRL-17773) CFSTI: HC$3.00/MF$0.65

A Valdré type heating and tilting stage was constructed for the Siemens electron microscope. The design characteristics and performance of the stage are described. The stage was found to have rapid temperature response, smooth tilting capability and negligible drift of the area under observation at temperatures up to 1000°C. The performance of the hot stage was tested by employing it to observe the HCP to FCC transformation (417°C) of cold rolled cobalt and the temperature dependence of Bloch type magnetic domain walls in HCP cobalt. With the specimen at 450°C the transformation was complete in a few minutes. The HCP grains nucleated heterogeneously and, in seconds, grew to a grain size of about 0.5 μ. The transformation temperature was used to calibrate the specimen thermocouple. Domain walls along [0001] were observed to widen and became diffuse at 150°C and disappeared below 300°C as predicted from previous measurements of magnetization versus temperature versus crystallographic direction. (NSA)

N68-31696# Minnesota Univ., Minneapolis. Dept. of Physics.
A LARGE AREA, HIGH CHARGE RESOLUTION, SCINTILLATION COUNTER TELESCOPE FOR COSMIC RAY STUDIES
T. T. von Rosenvinge and W. R. Webber Adelaide, Australia Adelaide Univ. Jul. 1968 26 p refs
(ADP-53) CFSTI: HC$3.00/MF$0.65

A cosmic ray telescope consisting of a 1.7 meter long gas Cerenkov detector sandwiched between two large scintillator detectors has been flown from balloons to study high energy heavy nuclei in the primary cosmic radiation. This paper discusses the design and testing of the scintillation detectors. It is demonstrated that geometry factors two orders of magnitude larger than are in common use can be achieved with no loss of charge resolution. With a geometry factor in excess of 500 cm^2-ster we have obtained unambiguous charge determination up to Z=20. This resolution is comparable to that obtainable with emulsions using photometric techniques. Author

N68-31733# Columbia Univ., Irvington, N. Y. Nevis Labs.
DESIGN SPECIFICATION, THEORY OF OPERATION, AND PRELIMINARY RESULTS FOR A "THERMISTOR PROBE" TO MEASURE SYNCHROCYCLOTRON INTERNAL BEAM CURRENT AND RESULTS FOR THE NEVIS SYNCHROCYCLOTRON INTERNAL PROTON CURRENT
J. Reinwater, E. Baron, R. Cohen, H. Dowds, R. Mobley et al 1968 83 p refs
(Grant NSF GP-7177)
(R-619; CU-270; NEVIS-166; PB-178207) CFSTI: HC $3.00/MF $0.65

A thermistor probe was developed and used to evaluate the internal proton current (time-average counting each proton just once) vs radius in the Nevis Synchrocyclotron. The method consists of measuring the heating produced in a 1/8-in. thick tungsten plate. The paper describes the probe and the measurements and their analysis. Part II describes the central region of the cyclotron and improvements made since September 1965 which have led to a factor of between two and four increase in the proton current. One change was to increase central region magnetic vertical focusing. The other main change was to develop and use a zirconium cold cathode pulsed ion source. Part III presents a comparison with available information on other synchrocyclotrons, emphasizing the internal proton currents. Author (USGRDR)

N68-31741# Lockheed Missiles and Space Co., Palo Alto, Calif.
ELECTRONOPTICAL SYSTEMS FOR RECORDING HIGH-SPEED PROCESSES
Yu. E. Nesterikhin and R. I. Soloukhin 1967 22 p refs Transl. into ENGLISH from the book "Methods of High-Speed Measurement in Gasdynamics and Plasma Physics," Moscow, Izd. Nauka, 1967 p 88–106
(PB-176848T) CFSTI: HC $3.00/MF $0.65

High speed moving picture cameras with large aperture ratio and high time resolution are needed for exposure and scanning of radiation spectra, investigations of the dynamics of high-temperature plasmas, exposure of processes in the light of individual spectrum lines, scintillation radiation, initial phases of breakdown and others, including non-self-illuminating phenomena. It is difficult or even impossible to satisfy these demands by utilizing mechanical optical systems, while the development of the necessary electron-optical units with appropriate control circuits is completely realizable. The very low inertia (up to 10 to the minus 14th power sec) of electron-optical converters, the possibility of a flexible control, the comparatively large frame size with high resolution, and the absence of moving parts assure wide application in investigations of various high-speed processes.
Author (USGRDR)

N68-31764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE OPTICAL IMAGING SYSTEMS FOR RANGER, MARINER, AND SURVEYOR TELEVISION
E. P. Martz, Jr. *In* NASA. Marshall Space Flight Center Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 43–50 (See N68-31759 19-07)

A summary is presented of some optical imaging hardware characteristics of these three projects. Illustrated and briefly described are the Cassegrainian telescopes with primary and secondary mirrors, fuzed quartz tubes, vidicon tubes, TV cameras and electronic packaging, mounts, camera telescopes, lenses, and associated components. The functioning of the equipment is also briefly discussed. K.W.

N68-31767*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNOLOGY FOR A MANNED ORBITING TELESCOPE
W. E. Howell *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 67–80 (See N68-31759 19-07)

The research program for a manned orbiting telescope discussed in this paper consists essentially of ground-based research on optics and control, study of a preliminary 15.24-cm system, and flight experiments to evaluate launch stresses, effects of zero g, thermal shielding, and man's ability to perform precise optical alignment and control. Considerations leading to the selection of a 304.8-cm (120-in.) telescope for further studies are discussed, including resolution versus aperture, physical size, and weight. Studies of typical mission objectives, attitude control, optical design and control, operation, stabilization, and thermal control are mentioned. Beryllium and fused silica are considered as mirror materials, and detector technology is briefly covered. The advantages and problems due to the presence of man are also summarized. K.W.

N68-31773*# National Aeronautics and Space Administration, Washington, D. C.
SOME ASTROPHYSICAL INSTRUMENTATION CONSIDERATIONS RELATED TO SPACE OPTICAL TECHNOLOGY
G. A. Vacca *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 131–142 (See N68-31759 19-07)

A review is presented of astrophysical instrumentation for measuring such phenomena as gravitational and electromagnetic fields, the radiation and composition of planetary atmospheres, interplanetary charge particle fields, and the spectra of stellar radiation. Among the subjects covered by this review are ionization gages, lasers, fiber optics, telescopes, electro-optical sensors, spectrometers and spectrophotometers, and such concepts as velocity of light and time measurements. The need for extension of measurable range, higher accuracies, combined effects of environmental parameters, development of standards, and development of calibration methods is stated. K.W.

N68-31790# Pennsylvania State Univ., University Park. Coll. of Earth and Mineral Sciences.
FURTHER DEVELOPMENT OF ULTRAVIOLET DOSIMETRY BY PLASTICS Final Report
Hans Neuberger and Lee C. Berry 31 Mar. 1967 49 p refs
(Grant CWB-WBG-46)
(PB-177734) CFSTI: HC $3.00/MF $0.65

The purpose of the study was to continue an investigation by Neuberger and Cochran into the use of Plexiglas for inexpensive ultraviolet dosimetry of global irradiance. Specifically, there were three objectives: Recalibration of the sensor; determination of a numerical factor that would correct for the observed effect of temperature on the sensor without resort to exposure on a hot plate; and construction of an instrument to measure the response of the sensor to UV more inexpensively than was done in the previously mentioned study. Author (USGRDR)

N68-31815# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A NEUTRON POLARIMETER WITH HIGH ENERGY RESOLUTION [POLARYMETR NEUTRONOW ODZNACZAJACY SIE WYSOKA ENERGETYCZNA ZDOLNOSCIA ROZDZIELCZA]
M. Sieminski, Z. Wilhelmi, W. Zych, and P. Zupranski 1968 13 p refs
(Rept.-897/I/PL) CFSTI: HC $3.00/MF $0.65

A new type of neutron polarimeter utilizing the n-alfa scattering as polarization analyser is described. The energy resolution obtained for 14 MeV neutrons amounts to about 14%. Author

N68-31818# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE SHAPE OF PULSES GENERATED BY α PARTICLES IN SILICON DRIFTED DETECTORS [KSZTALT IMPULSOW GENEROWANYCH PRZEZ CZASTKI α W KRZEMOWYCH DETEKTORACH DRYFTOWYCH]
M. Moszynski and W. Przyborski 1968 28 p refs Submitted for publication
(Rept.-887/IA/E) CFSTI: HC $3.00/MF $0.65

The paper presents the results of investigations of the shape of pulses generated by α particles in silicon drifted detectors having their active area 0.7 to 2.4 mm thick, under room and liquid nitrogen temperatures. It has been found, by fitting the analytical form of pulse to an experimental shape, that the electric field distribution in such detector is a parabolic function of depth. The distribution of concentration of donor impurities has been determined. Pulse risetimes have been determined as a function of the electric field average value and the thickness of detector active area. Some information has also been obtained about the influence of short term trapping on the process of charge collection. Author

N68-31904# Atomic Energy Commission Research Establishment, Riso (Denmark). DR 2 Reactor Group.
AN ELECTRONIC DEVICE FOR ADJUSTMENT AND CONTROL OF IONIZATION CHAMBERS

P. Z. Skanborg and P. Steen Jensen Feb. 1968 19 p ref In DANISH; ENGLISH summary
(RISO-M-678) CFSTI: $3.00

An electronic device suitable for adjustment and control of monitors using ionization chambers is described. The necessary test current appears when the chamber voltage is increased linearly with time. Author

N68-31905# Stanford Linear Accelerator Center, Calif.
METHOD OF STABILIZING HIGH CURRENT SECONDARY EMISSION MONITORS
E. L. Garwin and N. Dean Apr. 1968 5 p refs Presented at the Symp. on Beam Intensity Meas., Warrington, Engl., 23–26 Apr. 1968
(Contract AT(04-3)-515)
(SLAC-PUB-405; CONF-680427-4) CFSTI: HC $3.00/MF $0.65

The problem of fabricating secondary emission monitors which are stable in electron beams with current densities in the range 1 to 40 $\mu A/cm^2$ is studied. The problem consists of finding a foil coating material which does not sorb CO, and silver was found to be such a material. The vacuum evaporation procedure is described, and efficiency curves for the secondary emission monitors are presented. NSA

N68-31907# Stanford Linear Accelerator Center, Calif.
A PRECISION TOROIDAL CHARGE MONITOR AT SLAC
R. S. Larsen and D. Horelick Apr. 1968 36 p refs Presented at the Symp. on Beam Intensity Meas., Warrington, Engl., 23–26 Apr. 1968
(Contract AT(04-3)-515)
(SLAC-PUB-398; CONF-680427-3) CFSTI: HC $3.00/MF $0.65

A charge monitor system which utilizes a ferrite toroid operated in a resonant mode is described. The system is designed to monitor electron and positron beam pulses of ≤ 2 μsec duration having peak intensities of 50 μA to 50 mA, at a maximum rate of 360 pps. The digital accumulator which totalizes charge is bidirectional in order to reduce the effects of noise. For runs of 10^4 samples (≈ 30 seconds at 360 pps), the error due to noise is ≤ 0.1 percent of reading over a 1000:1 signal range. Faraday cup comparisons for currents greater than 1 mA peak show agreement to <1 percent, with a standard deviation of <0.1 percent. The system includes a built-in calibration and test facility; toroid temperature stabilization; digital displays for total charge, charge per beam pulse, and number of beam pulses; and digital outputs to a computer. Author (NSA)

N68-31917# Stanford Linear Accelerator Center, Calif.
A HIGH-PRECISION FARADAY CUP AND QUANTAMETER FOR SLAC
D. Yount Mar. 1968 35 p refs Presented at the Symp. on Beam Intensity Meas., Warrington, Engl., 23–26 Apr. 1968
(Contract AT(04-3)-515)
(SLAC-PUB-395; CONF-680427-1) CFSTI: HC $3.00/MF $0.65

Specifications and test data are given for a 20-GeV Faraday cup and quantameter. The Faraday cup has been designed to have unity efficiency for electrons or positrons to an accuracy of better than $\pm 0.1\%$ at energies up to 20 GeV. Recent data obtained with positrons as well as electrons and with secondary emission monitors, a calorimeter, and a toroid as well as ion chambers and the quantameter are consistent with those reported earlier indicating an absolute efficiency of $(100.0 \pm 0.2)\%$ at energies up to 15 GeV. The quantameter was designed to have a gain linear in electron, positron, or photon energy to $\pm 0.1\%$. In tests with the Faraday cup and other monitors using electron beams at Stanford and positron and electron beams at SLAC, the quantameter has been calibrated to $\pm 0.3\%$ and its linearity established to $\pm 0.2\%$ at energies up to 15 GeV. Author (NSA)

N68-31940# Bendix Corp., Southfield, Mich. Research Labs.
LIQUID METAL VAPOR QUALITY METER Final Report, Nov. 1965–Nov. 1967
H. W. Schwartz Jan. 1968 61 p
(Contract AT(04-3)-636)
(Rept.-3540; TID-24501) CFSTI: HC $3.00/MF $0.65

The application of a flueric device to sense the quality of potassium vapor is described. The flueric device is a delay line oscillator; its frequency is a function of the quality of a wet vapor flowing through it. Quality is the ratio of the vapor mass to the total mass of the vapor–liquid mixture (the higher the ratio, the drier the mixture). The delay line oscillator is a bistable fluid amplifier with delay lines connecting the outputs back to the respective control ports of the amplifier. The operating principle of the oscillator was analyzed, and an oscillator was designed and built that would vary its output frequency as a function of the potassium quality. A frequency range between 900 and 980 hertz was established for quality ranging from 80 to 100 percent for potassium vapor at 1400°F. An expected frequency range between 1100 and 1180 Hertz, for the quality range from 80 to 100 percent, was indicated by test data using NaK-78. Thus, the resolution was 4 hertz for each one-percent change of quality. Author (NSA)

N68-31949# Princeton-Pennsylvania Accelerator, Princeton, N. J.
P.P.A. BEAM MEASUREMENT
J. L. Kirchgessner, C. L. Kang, and J. Henness 11 Apr. 1968 17 p refs Presented at the Symp. on Beam Intensity Meas., Warrington, Engl., 22–26 Apr. 1968
(Contract AT(30-1)-2137)
(PPAD-640-E; CONF-680427-2) CFSTI: HC $3.00/MF $0.65

A beam monitoring system for the Princeton–Pennsylvania Accelerator is described which takes advantage of the following beam properties: (a) the beam is tightly bunched (2.5 nsec) separated by 33 nsec, because the rf remains on during the extraction process and (b) there is less than 1% frequency modulation during the 10 msec extraction time over the top of the magnet cycle. The beam monitoring system is composed of a ferrite loaded cavity tuned to 60 MHz (the second harmonic of the rf frequency) in order to minimize induced pickup from the rf system. An ionization chamber was used for obtaining fast beam position information on the extracted proton beam. The principle of operation of this chamber is discussed. NSA

N68-31958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODIFIED VIBRATION TRANSDUCER CALIBRATION SYSTEM WHICH DIRECTLY YIELDS A PLOT OF SENSITIVITY VERSUS FREQUENCY
William C. Nieberding, Edward F. Miller, and David L. Wright Washington Aug. 1968 16 p ref
(NASA-TN-D-4760) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A commercially available vibration transducer calibration system was modified to directly produce an output plot of transducer sensitivity versus frequency over the range of frequencies from 10 to 10,000 Hz. This was accomplished by the insertion of a readily programmed automatic attenuation in the exciter control-system feedback loop to maintain constant vibration amplitude versus frequency. National Bureau of Standards primary calibration data are repeated to within ± 0.5 percent over the frequency range of 10 to 9000 Hz and within ± 1 percent from 9000 to 10,000 Hz. Calibrations are obtained in 15 minutes. Author

N68-32016*# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
CALIBRATION OF AERODYNAMIC DYNAMOMETERS AND BALANCES AT THE MODANE-AVRIEUX TEST CENTER

M. Dubois NASA Jul. 1968 25 p refs Transl. into ENGLISH of ONERA-TP-452 Rept. Presented at the Mesucora Congr., Paris, 17–21 Apr. 1967
(Contract NASw-1693)
(NASA-TT-F-11472) CFSTI: HC$3.00/MF$0.65 CSCL 14B

The wind tunnel laboratories design dynamometers and aerodynamic balances for measurement and analysis of the stresses of one or more components. The gauges are generally designed to measure six components, e.g., the three forces and the three moments to which the mockups are subjected in the wind tunnel. Up to the present time, some 50 balances and about 100 dynamometers have been produced, with capacities from 1 daN to 1,000 kN. The indicator elements consist in most cases of strain gauges. The operations for strain-gauge installation and thermal and manometric calibration are briefly indicated. The conditions required for obtaining the desired qualities of precision and accuracy are succinctly outlined. Methods of dynamometric calibration and measuring circuits utilized are described together with the characteristics of the various calibration benches. Author

N68-32113# European Space Research Organization, Paris (France).
SPACECRAFT TECHNOLOGY. VOL. 3: INSTRUMENTATION
Nov. 1966 176 p In ENGLISH and FRENCH Proc. of 2nd ESRO Summer School, Oxford, 1964
(ESRO-SP-11) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. GENERAL INTRODUCTION TO INSTRUMENTATION PROBLEMS Pierre Blassel (European Space Technol. Center) 12 p (See N68-32114 19-14)

2. FREQUENCY-DIVISION MULTIPLEXING/FREQUENCY MODULATION (FM/FM) TELEMETRY J. Toussaint (European Space Technol. Center) 24 p (See N68-32115 19-07)

3. PULSE CODE MODULATION TELEMETRY J. Toussaint (European Space Technol. Center) 24 p (See N68-32116 19-07)

4. PULSE FREQUENCY MODULATION TELEMETRY J. Toussaint (European Space Technol. Center) 14 p (See N68-32117 19-07)

5. SATELLITE LOCALIZATION SYSTEMS J. Le Peltier (European Space Technol. Center) 42 p (See N68-32118 19-07)

6. LAUNCHING BASE ORGANIZATION J. B. Lagarde (European Space Technol. Center) 18 p (See N68-32119 19-11)

7. ORGANIZATION OF A NETWORK OF STATIONS FOR THE ACQUISITION OF SATELLITE DATA G. C. Tootill (European Space Technol. Center) 9 p (See N68-32120 19-11)

8. REDUCTION OF SATELLITE TELEMETRY DATA W. Lloyd (European Space Data Center) 19 p (See N68-32121 19-08)

9. SYNCHRONIZATION DEVICES IN SPATIAL INSTRUMENTATION J. Labrousse (European Space Technol. Center) 10 p (See N68-32122 19-17)

N68-32114# European Space Technology Center, Delft (Netherlands).
GENERAL INTRODUCTION TO INSTRUMENTATION PROBLEMS [INTRODUCTION GENERALE AUX PROBLEMES D'INSTRUMENTATION]
Pierre Blassel *In* ESRO Spacecraft Technol. Vol. 3 Nov. 1966 12 p In FRENCH *Its* Conf. No. 24 (See N68-32113 19-14)

Introductive lecture given at ESRO Summer School on instrumentation problems. Three main problems are discussed: telemetry, satellite localization, and event synchronization. Each is defined, justified, and general rules are given to solve them. ESRO

N68-32122# European Space Technology Center, Delft (Netherlands).
SYNCHRONIZATION DEVICES IN SPATIAL INSTRUMENTATION [LES MOYENS DE SYNCHRONISATION EN INSTRUMENTATION SPATIALE]
J. Labrousse *In* ESRO Spacecraft Technol. Vol. 3: Nov. 1966 10 p *In* French *Its* Conf. No. 33 (See N68-32113 19-14)

The necessity for synchronization of time measuring instruments is explained. Corrections necessary to take into account the aging of quartz piloted oscillators are presented. ESRO

N68-32125# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
CONSTRUCTION OF A TELEVISION TUBE WITH CHARGE INTEGRATION [REALIZZAZIONE DI UN TUBO TELEVISIVO AD INTEGRAZIONE DI CARICA]
L. Bartolini, A. Giangrande (Consiglio Nazl. Delle Ric., Frascati, Italy), R. Habel, and F. Paresce (Consiglio Nazl. Delle Ric., Frascati, Italy) 6 Jun. 1968 11 p refs In ITALIAN *Its* Nota Interna No. 404
(LNF-68/34) CFSTI: HC$3.00/MF$0.65

Astronomical observations with the telescopes installed on artificial satellites are believed to open access to a vast zone of electromagnetic spectra free of interference by atmospheric absorption. The ideal system for this type observation should have a great capacity for the accumulation of photographic images with the capability of responding to signals and readily transmitting the acquired data to earth. One system that is considered to fulfill both these requirements is the image storage tube, which registers the image on a superfiche by static charges retaining the configuration of the target and which responds on command of the user. Transl. by F.O.S.

N68-32172# Solar, San Diego, Calif.
HIGH TEMPERATURE SENSORS FOR SMALL GAS TURBINES Final Report, 1 Apr. 1966–7 Jul. 1967
A. Marshall Gaylord and William A. Compton Apr. 1968 134 p refs
(Contract DA-44-177-AMC-380(T))
(RDR-1479; USAAVLABS-TR-67-76; AD-671021)

The report describes an experimental program performed to generate technology on high temperature sensor concepts for small gas turbines. Major emphasis was placed on the definition of material systems needed for transducers with long life, good reliability, and fast response for sensing turbine inlet temperatures in the range of 2200 to 2500F with transients to 3000F. The technology related to three types of sensors was considered: thermocouples, resistive devices, and radiation pyrometers. Inherent material problems with resistive devices at temperatures above 1600F limited the experimental program on this concept. Thermocouple and radiation sensors were studied extensively, resulting in several promising approaches. Two types of thermocouple probes were found to have potential application to turbine engines. A proposed protected thermocouple junction offers best reliability and durability, but has relatively slow response to changes in gas temperature. A suggested exposed Pt-Rh junction has much improved response rate; however, the reliability and durability are much less than the protected junction. Five commercial radiation pyrometers were evaluated and one concept chosen as having, by far, the greatest potential for application to turbine engines. The sensor employs a silicon p-n junction photovoltaic detector. The sensor demonstrated microsecond response, good accuracy, and good reliability as long as the environmental temperature for the silicon chip was kept below 250F and the window was maintained clean. A unique air-collimator lens was devised which acts as an interface between the turbine gas path and the sensor window. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-30955*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A STUDY OF RESIDUAL STRESS INDUCED DURING ROLLING

E. V. Zaretsky, R. J. Parker, and W. J. Anderson Washington 1968 21 p refs To be presented at the Lubrication Conf. sponsored by ASME and Am. Soc. of Lubrication Engr., Atlantic City, 8–10 Oct. 1968

(NASA-TM-X-52422) CFSTI: HC$3.00/MF$0.65 CSCL 13I

Subsurface residual stress measurements were made on SAE 52100 steel inner races from 207-size deep-groove ball bearings in which ΔH (ball hardness minus race hardness) ranged from −1.1 to 3.5 points Rockwell C. These bearings had been run at an inner-race speed of 2750 rpm and a radial load of 1320 pounds producing maximum Hertz stresses of 352,000 and 336,000 psi at the inner and outer races, respectively. The residual stress measurements were made in a circumferential direction at various depths below the inner-race running track surface for a total of 19 of these bearings that had been run for nominally 200, 600, and 1600 hours. The measurements indicate that the maximum compressive residual stresses occur in approximately the same ΔH range for which the maximum fatigue lives were observed. No relation between running time and residual stress could be determined from these measurements. Author

N68-31126# Vitro Labs., West Orange, N. J.

DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR COATING T-53 AIR DIFFUSER, EXHAUST DIFFUSER, AND COMBUSTION CHAMBER HOUSING WITH SERMETEL (TRADE NAME) W, PHASE 4 Technical Report, 22 Jan.–21 Apr. 1968

Kenneth A. Gebler Apr. 1968 18 p

(Contract DAAJ01-67-C-2207)

(VL-2488-4-0; AD-670975)

This report covers activities accomplished during Phase IV of a ten (10) month program to develop an electrophoretic coating method for the application of a corrosion-resistant coating to all critical surfaces of the exhaust diffuser, air diffuser and combustion chamber housing of the T-53 Engine. During this phase full scale coating trials were made. Methods were developed for cleaning, coating, humidification and baking of parts. The coated parts were also given a 300 hour salt spray corrosion test. Author (TAB)

N68-31189# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

CORRELATION OF EMISSION AND ATOMIC ABSORPTION TECHNIQUES ON THE ANALYSIS OF LUBRICATING OIL SAMPLES FOR WEAR METAL CONTAMINATION

Donald C. Kittinger and John L. Ellis Apr. 1968 35 p

(ASD-TR-68-2; AD-671115)

The objectives of the effort were to gather a large amount of emission and atomic absorption data on controlled oil samples and to tabulate these data to indicate what correlations, if any, existed within each technique as well as between the two techniques. One hundred and ninety samples were analyzed by 25 different laboratories using their particular techniques. The samples consisted of repeat and standard samples for testing laboratory repeatability and accuracy, respectively. Accuracy indices based on the standard samples were computed to relate laboratory accuracies. The precision of each laboratory was tabulated as a function of element, acceptability, and overall comparison with other laboratories. This effort has shown that both the emission and the atomic absorption equipment have potential for precision and accuracy. With the acquirement of precise equipment and the establishment of standard operating procedures, data can be generated and correlated among different techniques, laboratories, or bases. Different results on identical oil samples have been shown to be caused by a lack of standardization among the laboratories. Correlation is essential to the effectiveness of the Spectrometer Oil Analysis Program. Author (TAB)

N68-31192# European Space Technology Center, Noordwijk (Netherlands).

THE PREPARATION OF THIN SAMPLES OF SILICON FOR OBSERVATION WITH AN ELECTRON MICROSCOPE [LA PREPARATION D'ECHANTILLONS MINCES DE SILICIUM POUR L'OBSERVATION AU MICROSCOPE ELECTRONIQUE]

M. Fabricotti Paris, ESRO Jan. 1968 16 p refs In FRENCH; ENGLISH summary

(ESRO-TM-112) CFSTI: HC$3.00/MF$0.65

A jet chemical polishing apparatus for the preparation of silicon specimen to be observed by transmission electron microscopy has been constructed. The etching solution consists of 1 HF+9 HNO_3. A good control of the end of the thinning operation is achieved by directing a jet of water onto the specimen. Some applications of this method to the analysis of defects in silicon solar cells are presented. ESRO

N68-31265# Washington Univ., Seattle. Lab of Statistical Research.

ON THE IMPORTANCE OF DIFFERENT COMPONENTS IN A MULTICOMPONENT SYSTEM

Z. W. Birnbaum 20 May 1968 24 p refs

(Contract Nonr-477(38))

(TR-54; AD-670563)

In a system whose functioning or failure depends on the functioning or failure of its components, some components may play a more important part than others. A quantitative definition of this notion of importance is proposed in the present paper for systems with coherent structures, assuming (1) that only the structure of the system is known, or (2) that also the reliabilities of all components are known. Some theoretical properties of the so defined concepts are discussed, and applications are presented to such problems as allocation of spare parts or appropriation of funds for improvement of component reliability. Author (TAB)

N68-31298*# Oklahoma State Univ., Stillwater. Fluid Power Controls Lab.

STUDY OF FILTRATION MECHANICS AND SAMPLING TECHNIQUES, PHASE 4 Annual Report, 1967–1968

E. C. Fitch, R. E. Reed, and D. E. Long Jul. 1968 113 p refs

(Contract NAS8-11009)

(NASA-CR-61911) CFSTI: HC$3.00/MF$0.65 CSCL 13H

A program designed to establish a scientific basis for solving problems related to filtration mechanics and fluid contamination is reported. Summarized are details and results of studies focusing on the following: (1) the establishment of a physically meaningful cleanliness level criteria for fluids which expresses in quantitative terms the contamination level; (2) the filtration characteristics of

filter media as exemplified by their effect on contamination levels; (3) expressions for the contaminant tolerance level of components in terms of a rigorous cleanliness level criteria; and (4) the performance and specification of depth type filter media as they are related to the physical parameters of the matrix. Author

N68-31357*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF TECHNIQUES TO IMPROVE BLADDER MATERIALS AND TEST METHODS Final Report, May 18, 1966–May 17, 1968
R. F. Muraca, J. S. Whittick, and A. A. Koch 17 Jun. 1968 118 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951484)
(NASA-CR-95992) CFSTI: HC$3.00/MF$0.65 CSCL 13H

Process parameters are described for the fabrication of flexible Teflon films from aqueous dispersions; the experimental films were characterized by electromicrography, determinations of crystallinity, the measurement of crease-and-fold resistance, and other determinations. Analyses of original dispersions for impurities are also given. The determination Teflon crystallinity by several procedures is discussed and data are presented for the solubility of N_2O_4 in Teflon, the swelling created by the solubility, and the relationship of density to crystallinity in compacted Teflon powders. Techniques are reported for the electroplating of Teflon films with lead in order to reduce their permeabilities to N_2O_4. A description is given of an all-Monel vacuum system for handling OF_2 and B_2H_6. Details of design and performance of a micro crease-tester for testing polymeric films while they are immersed in liquid propellants are also given. Author

N68-31367*# Philco-Ford Corp., Newport Beach, Calif. Space and Re-Entry System Div.
DEVELOPMENT OF ADVANCED SOIL SAMPLER TECHNOLOGY–TASK E Final Report, 1 Jan.–8 May 1968
Wilfred H. Bachle 8 May 1968 137 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951935)
(NASA-CR-95994; UG-4410) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Design criteria were defined and eight prototype designs were completed for six soil sampling mechanisms and two soil processing mechanisms. These designs were completed in sufficient detail to allow reasonable estimates of the weight, size, and complexity to be made. These designs are based on breadboard models built and tested by the Jet Propulsion Laboratory, Philco-Ford and Hughes Tool Co. The completed prototype designs represent a well defined starting point for more detailed design analysis and development of soil sampling mechanisms to support future surface probes. It is concluded that these soil sampling mechanisms are of sufficiently light weight and compact size to warrant consideration as part of the payload complement of an early unmanned planetary or lunar payload. Author

N68-31404*# Boeing Co., Seattle, Wash. Space Div.
LARGE AREA SOLAR ARRAY Quarterly Report—Phase 2, 1 Mar.–31 May 1968
R. C. Weikel, F. W. McAfee, J. L. Apperson, and Dwight A. Norsen Jun. 1968 252 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951934)
(NASA-CR-95999; D2-113355-6, Pt. U; QR-3) CFSTI: HC $3.00/MF$0.65 CSCL 13H

Following a summary of engineering, technology, and manufacturing activities relating to the development of a large area solar array, details are presented of the various aspects of the development program. Design and requirements are stated, and the effect of boost environment on design is detailed. The latter includes the dynamic and internal loads for stowed configurations, vibration and stress-deformation analyses, the prestress conditions, and temperature distribution and temperature control aspects. Both ground and space release and deployment are covered, and electrical power source design and performance analysis are reviewed. Attention is also given to process development and material properties, quality assurance and reliability, and weight status; and critical safety margins are summarized. M.W.R.

N68-31428# Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC WALL THICKNESS MEASUREMENT IN PRESSURE VESSEL INSTALLED IN COMPANHIA PUMEX DE CONCRETO CELULAR [SONDAGEM-ULTRA-SONICA DE AUTOCLACE INSTALADA NA COMPANHIA PUMEX DE CONCRETO CELULAR]
C. Mendonca Filho and M. F. Barbosa 27 May 1968 6 p refs In SPANISH; ENGLISH Summary
(LXN/NP-680527; Rept.-6805.327

The procedures and equipment used in the ultrasonic measurements of wall thickness for corrosion control in a pressure vessel are discussed. Charts are presented indicating thickness measurements. Author

N68-31478*# Research Triangle Inst., Durham, N. C.
PRACTICAL RELIABILITY. VOLUME 1: PARAMETER VARIATIONS ANALYSIS
Washington NASA Jul. 1968 92 p refs (Contract NASw-1448)
(NASA-CR-1128) CSCL 14D

Concepts such as model, randomness, statistical ignorance, and statistical independence are explored and explained. The effects of variations of parameters can be evaluated by changing components in a physical model or by creating a conceptual/mathematical model of the system and then analyzing it. There are only a very few basic techniques for analysis of mathematical models and these are rather extensively treated. The uses to which these models and their analyses may be put are many and only a few of these are treated such as sensitivity and worst-case analyses, and calculation where extreme extrapolation is necessary. There is a brief discussion of the sources and uses of variations data both in purchased and in manufactured items. A series of appendices gives some mathematical details, thus saving constant reference to other books. Author

N68-31522*# National Aeronautics and Space Administration, Washington, D. C.
LUBRICATION, CORROSION AND WEAR. A CONTINUING BIBLIOGRAPHY WITH INDEXES
Jul. 1968 240 p refs
(NASA-SP-7020(02)) CFSTI: HC$3.00/MF$0.65 CSCL 11F

This publication is the second supplement to the continuing bibliography *Lubrication, Corrosion and Wear*. It contains references to reports and journal articles on lubricating systems, design and performance of bearings; special applications of lubricants, e.g., as heat transfer and anticorrosion agents; stress corrosion and fatigue cracking in metals and alloys; friction and wear characteristics of materials; and corrosion types and techniques for corrosion prevention. In addition, references describing the instrumentation and methods for the testing of lubricants are included. Author

N68-31529# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
STUDY ON FABRICATION OF THIN FILMS WITH A HIGH REFLECTION COEFFICIENT IN THE FAR ULTRAVIOLET [ETUDE POUR LA FABRICATION DE COUCHES MINCES A HAUT POUVOIR REFLECTEUR DANS L'ULTRAVIOLET LOINTAIN]

M. Guillard *In Its* Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 4–24 refs (See N68-31528 19-23)

Aluminum has the highest possible reflection coefficient for Lyman α radiation but to prevent oxydation even in ultra vacuum the reflector must be coated with magnesium fluorides. Fabrication problems of such reflectors are discussed with evaporation in vacuum or high vacuum. A device has been designed to control the fabrication and measure the reflection coefficient. ESRO

N68-31531# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).

FABRICATION OF CONCAVE DIFFRACTION GRATINGS ON BERYLLIUM THIN FILMS [FABRICATION DE RESEAUX CONCAVES SUR SUPPORT EN BERYLLIUM]

J. M. Lamenardie *In Its* Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 29–33 refs (See N68-31528 19-23)

A study is made on thermal control of tracing machines, quality control, influence of the support on which the grating is engraved, precise setting of the cutting diamond. Special attention is paid to large concave gratings. ESRO

N68-31533# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).

RELIABILITY OF COMMAND ELECTRONICS OF A MACHINE FOR TRACING OPTICAL DIFFRACTION GRATINGS [FIABILITE DE L'ELECTRONIQUE DE COMMANDE D'UNE MACHINE A TRACER]

P. Albertinoli *In Its* Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 38–48 (See N68-31528 19-23)

Interference grating must be grooved in one operation without any break in the process. As this operation might last for some 1000 hours it is essential that the electronic command and mechanical parts of the machine offer a reasonable chance of performing the work. Reliability analysis is done on machine parts and components. ESRO

N68-31536# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).

STUDY ON THE FABRICATION OF BERYLLIUM MIRRORS [ETUDE POUR LA FABRICATION DE MIROIRS EN BERYLLIUM]

M. Guillard *In Its* Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 66–68 (See N68-31528 19-23)

The beryllium mirrors described in this study have been produced for OGO satellites. The following fabrication methods are indicated: electromachining, nickel coating, polishing and quality control. ESRO

N68-31550# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

EXPLORATIONS OF THE COGNITIVE PROCESSES IN DESIGN

Charles M. Eastman Feb. 1968 103 p refs

(Contract ARPA SD-146)

(AFOSR-68-1374; AD-671158)

Intuitive design, as carried out by architects, product designers, and some engineers, is analyzed as a problem solving task within the framework of an information processing theory of cognition. A study of intuitive design processes was carried out utilizing four protocols as experimental data. Two of the protocols are presented in this report in their entirety. From the protocols were identified the information used, the transformations carried out on the information, and some of the administrative processes directing particular sequences of activities. Analysis of the protocols led to an operational model of design and hand simulations largely replicating one protocol. Fundamental issues of design methodology are outlined. Of particular interest is the insight offered into semantic memory retrieval processes utilized by designers and the representational languages used in complex problem solving. Author (TAB)

N68-31681*# Boeing Co., Seattle, Washington. Space Div.

IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Final Report

R. W. Rice, J. G. Hunt (Whittaker Corp.), G. I. Friedman (Whittaker Corp.), and J. L. Sliney (Whittaker Corp.) Aug. 1968 300 p refs Prepared jointly with Whittaker Corp.

(Contract NAS7-276)

(NASA-CR-95971) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A study of the hot extrusion of refractory oxides was made with the primary goal being to improve their strengths. Most extrusion was in thick wall metal cans using conventional extrusion techniques. However, high temperature hydrostatic extrusion was shown to be feasible using various soft salts, either solid or molten, though the former appears best. Some hot (press) forging was also done. MgO, CaO, and ZrO_2 were the most extrudable oxides. NiO and CaO_2 showed problems of decomposition, while Al_2O_3 and $MgAl_2O_4$ were generally too stiff. Cracking often occurred due mainly to thermal stresses, but crack free bodies could be obtained. Extruded oxides and oxide alloys are characterized to show the texturing, grain elongation, recrystallization, and slower grain growth of such bodies. Extrusion generally increased strengths, especially the high temperature strengths of MgO. Fracture origins were frequently located. This and analysis of strengths provided much information on fracture nucleation and propagation, such as the preference of fracture for texture directions and surface work hardening of softer materials by sanding so internal fracture origins occur. All of the data indicates that dislocation crack nucleation is the major factor in the strength of MgO and CaO. Results of tests with different texture-stress orientations indicate that further study of slip and grain boundary effects are needed. Author

N68-31792# Tennessee Valley Authority, Oak Ridge.

THE USE OF A HIGH-FREQUENCY ELECTRODELESS PLASMATRON FOR THE PRODUCTION OF PURE SILICON AND SILICON OXIDES

F. B. Vurzel, N. N. Dolgopolov, A. I. Maksimov, L. S. Polak, and V. I. Fridman 2 Aug. 1966 12 p refs Transl. into ENGLISH from the Book "Kinetika i Termodinam. Khim. Reaktsii v Nizkotemperaturnoi Plazme" Moscow, Izd. AN SSR, 1965 p 223–232

(TVA-4198; PB-178094T) CFSTI: HC $3.00/MF $0.65

A study was of processes for obtaining silicon and silicon carbide films with semiconductor properties and also powders of silicon monoxide and finely dispersed silicon dioxide with an electrodeless plasmatron. USGRDR

N68-31871# Boeing Co., Philadelphia, Pa. Vertol Div.

AN EVALUATION OF CONFORMAL CONTACT GEARS Final Report

A. J. Lemanski, J. P. Alberti, and J. C. Mack Jan. 1968 71 p refs

(Contract DA-44-177-AMC-389(T))

(D8-0854A; USAAVLABS-TR-67-83; AD-670959)

The report concludes the program for the evaluation of one form of the conformal gear geometry. The program comprised the design, fabrication, inspection, and load testing of one form of the conformal gear tooth geometry. The test gears were case-carburized and ground in accordance with high aircraft quality standards and the applicable specifications. Load capacity of this particular tooth form was determined by a programmed increase

in load until failure was attained. Results of this test program indicated that the gear member was the weakest in bending strength, and that a better balance between contact stress and bending stress will be necessary in future designs. Author (TAB)

N68-31882# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
SOME MATHEMATICAL MODELS OF INSPECTION ALONG A PRODUCTION LINE
Earl Douglas Brown May 1968 193 p refs
(Contract Nonr-3963(06))
(TR-36; AD-670753)

A production line is taken to be an ordered series of manufacturing operations separated by potential inspection stations. The study concerns two primary aspects of inspection along a production line through which item goods are processed. First, when the system characteristics which affect final quality are not known with certainty, the problem of allocating costly inspection throughout the line is considered. Two models are presented, analysed and combined. Dynamic programming formulations are closely analysed and much attention is given to securing bounds on their operation and on the optimal solution. A case is demonstrated where two such formulations may be combined to the advantage of each. Secondly, when the system characteristics are known with certainty, there is the problem of installing a combined inspection and disposition plan in order to control the final quality. Two models are described and for each the properties of the optimal solutions are discussed. For a long-term-cost model, an all or nothing property is proved for the optimal inspection as well as for the optimal disposition plans, but the question is reopened for the long-run-quality model. Various classes of quality control procedures and costs are considered. Author (TAB)

N68-31897# Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF B-17 AIRCRAFTS OPERATED BY FORCA AEREA BRASILEIRA LANDING GEARS [INSPECAO ULTRA-SONICA DAS PERNAS DE FORCA DE AVIOES B-17 OPERADOS PELA FORCA AREA BRASILEIRA]
H. Onusic 29 May 1968 8 p In PORTUGUESE; ENGLISH Summary
(Rept.-6805.329) CFSTI: HC $3.00/MF $0.65

Details are given on the landing gears, the equipment and accessories used, and the procedure adopted for the ultrasonic inspection of B-17 landing gears. Results are presented in schematic form illustrating the different parts of the landing gears. Author

N68-31929# National Engineering Lab., Glasgow (Scotland). Machinery Group.
A DESIGN METHOD FOR HYDRODYNAMIC JOURNAL BEARINGS
R. G. Woolacott and D. Macrae Aug. 1967 56 p refs
(NEL-315) CFSTI: HC $3.00/MF $0.65

A method is presented for designing pressure fed steadily loaded hydrodynamic journal bearings. Extensive direct reading charts enable a design to be obtained in a few minutes. Charts for load capacity, lubricant viscosity, lubricant flowrate and power loss are given for a wide range of bearing sizes and clearances. Author

N68-31979*# Research Triangle Inst., Durham, N. C.
PRACTICAL RELIABILITY, VOLUME 4: PREDICTION
C. A. Krohn et al Washington NASA Aug. 1968 188 p refs
(Contract NASw-1448)
(NASA-CR-1129) CFSTI: HC $3.00/MF $0.65 CSCL 14D

The features and techniques of reliability prediction are identified and brought together in this report. Part I is largely qualitative discussion concerned with introduction and perspective. Contents include discussion and opinions on the role of reliability prediction, on perspective features, e.g. program phase and hardware level, on the relation to other analyses, and on the problems. Part II is concerned with reliability measures or definitions concerning single items, including data sources. Part III is devoted to the reliability prediction techniques which are suitable for general use and to classical reliability models. This material is scattered throughout the references; the treatment here mainly identifies approaches and relates them, with reliance on the references. Included for multi-item models are logic, lifetime, environment and bound-crossing topics. The remaining Part IV is concerned with concepts related to the detailed treatment of failure modes without independence assumptions. This is food-for-thought material from the results of research on reliability prediction techniques. This material in Part IV, in general, is not suited for widespread application. The Appendix presents a ready reference on some basic probability laws and on various probability distributions. Author

N68-31980*# Research Triangle Inst., Durham, N. C.
PRACTICAL RELIABILITY VOLUME 5: PARTS
B. M. Berry Washington NASA Jul. 1968 78 p refs
(Contract NASw-1448)
(NASA-CR-1130) CFSTI: HC $3.00/MF $0.65 CSCL 14D

Parts reliability and associated problems are discussed. This includes those functions—selections, specification, verification, review processes, and data sources—which are involved in a successful parts program. Some of the costs associated with these functions are discussed and an attempt is made to define an ideal data bank. Author

N68-31984*# Littleton Research and Engineering Corp., Mass.
DEVELOPMENT OF NON RESONANCE PIEZOELECTRIC ACTUATED FATIGUE MACHINE Final Report
F. Everett Reed, William T. Hogan, Robert W. Reid, John M. Rush, David L. Hartford et al Jul. 1968 34 p ref
(Contract NAS1-5943)
(NASA-CR-66670) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A piezoelectric actuated fatigue machine has been designed, built, and tested. The machine is capable of subjecting a specimen to a cyclic load up to ±2000 lbs, and deflection amplitudes up to ±.005 in. The first natural frequency of the machine and specimen system is approximately 770 cycles per second. The operating frequency range of the machine could be increased substantially beyond the first natural frequency by proper electronic modification of the input signal. The load transducer consists of piezoelectric crystal discs bonded together so as to form a cylinder. The design incorporates precompression of the crystal stack by means of tie rods in order that the epoxy bond between the discs will not be subjected to a tensile load when the stack is energized. The mechanical design of the machine is such as to maximize the first natural frequency of the structure. Such design was dictated by the requirements of a nearly constant magnification factor over the desired frequency operating range to insure accurate input–output response. Author

N68-31985# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ULTRASONIC DEFECTOSCOPY
D. S. Shrayber 11 Aug. 1967 410 p refs Transl. into ENGLISH of the book "Ul'trazvukovaya Defektoskopiya" Moscow, Izd. Metallurgiya, 1965 p 1–391
(FTD-MT-66-45; AD-670980)

The theoretical fundamentals of defectoscopy, the types of metallurgical defects in materials which can be detected

defectoscopically, the equipment used, and the most effective defectoscopic methods are presented. Author (TAB)

N68-32066# Institut Franco-Allemand de Recherches, St. Louis (France).
CONSTRUCTION OF AN ION GUN FOR ETCHING OF METALLOGRAPHIC POLISHED SURFACES [REALISATION D'UN CANON A BOMBARDMENT IONIQUE POUR L'ATTAQUE D'ECHANTILLONS METALLOGRAPHIQUES]
A. Lichtenberger, C. Jessen, and H. G. Otto 28 Dec. 1966 15 p refs In FRENCH
(Contract T-654-i-206)
(ISL-T-46/66) CFSTI: HC $3.00/MF $0.65

An ion gun was constructed that permits the etching of metallographic surfaces by a physical process as well as etching by chemical reactions, although the latter exhibited little efficiency. The overall procedure has the advantage of etching only a small surface of the sample whereas the classical method reached the entire surface as well as the materials in contact with the surface. It is noted that the use of ion clusters for etching was originally proposed in 1948. The present study describes the apparatus used and its capabilities and indicates possibilities of the new etching technique. Transl. by M.W.R.

N68-32174 Institute of Nuclear Research, Warsaw (Poland).
MECHANISM OF THE MOVEMENT THE CHANGE MATERIAL IN ROTARY KILNS—MATHEMATICAL DESCRIPTION OF THE CHANGE SPEED FLOW MATERIAL [MECHANIZM PRZEPLYWU WSADU W PIECACH OBROTOWYCH—MATEMATYCZNA INTERPRETACJA ZMIANY SZYBKOSCI PRZEPLYWU WSADU]
Wladyslaw Zablotny 1967 85 p refs In POLISH; ENGLISH summary
(Rept.-864/XVI/J) CFSTI: $3.00

Experiments on the determination of the influence of individual parameters on the rate of charge shifting along the model rotary kiln were carried out. On the basis of experimental data an equation composed of dimensionless expressions and describing the phenomenon of charge shifting in rotary kilns was obtained. Results are given of isotopic measurements of displacement rate of the charge in various lengths along industrial furnaces. On the basis of the formula given it is possible to carry out analysis of extended furnaces and to compute the time of passage of the charge in the kilns designed. Author

N68-32187*# Southern Methodist Univ., Dallas, Tex. Inst. of Technology.
DIFFERENTIAL ION PUMPING FOR VACUUM DEPOSITION
W. F. Leonard [1968] 6 p ref
(Grant NGR-44-007-006)
(NASA-CR-95949) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Since it is desirable to reduce the ultimate pressure that can be maintained during vacuum deposition to obtain films with low impurity content, the feasibility of using the concept of differential pumping in a bakeable ultra high vacuum ion pump system to achieve lower pressures in the vicinity of the substrate was investigated. During actual deposition with copper as a source material, the pressure in the substrate chamber remained below 7.5 $\times 10^{-8}$ Torr for deposition rates between 10 to 20 Å/sec. Attempts to increase the deposition rate were hindered because the conductance tube, which was at ground potential, perturbed the electric field of the electron beam gun at large powers. Partial pressures were also measured before and during deposition of copper using a Varian partial pressure ionization gauge. The predominate peaks in both cases were H_2, H_2O, and N_2 with traces of CO_2. During deposition, a proportionally larger increase of H_2 and CO_2 from the source material and gun occurred. It is concluded that although various techniques not yet incorporated in the system exist to further reduce the gases in the substrate chamber during deposition, even without these improvements, system performance is attractive since differential pressures of 200/1 or greater than 200/1 were easily obtained under heavy gas loads in the source chamber. S.C.W.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-30896 Illinois Univ., Urbana.
PART 1: HYDRODYNAMIC BEHAVIOR OF MULTI-SUBUNIT PARTICLES. PART 2: LASER-RAMAN INVESTIGATIONS
William Owen Dalton (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-11842

Particles were approximated by a collection of spherical subunits for the purpose of calculating hydrodynamic properties. Kirkwood's theory was extended to subunits of unequal size and the validity of the theory for compact structures was studied. This approach gave the correct frictional coefficient for tightly packed subunits on the surface of a sphere and was only slightly in error when used to approximate an ellipsoid. A pulsed ruby laser was constructed and used for a light source for Raman spectroscopy and a commercial instrument using a continuous wave helium-neon laser was purchased. The apparatus with the pulsed laser was adequate for the spectroscopy of some simple organic solvents but was not suited for work requiring higher sensitivity. Dissert. Abstr.

N68-31425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT SYSTEM OF THE ACTIVE ELEMENT OF A PULSED LASER OF FINITE LENGTH [TEPLOVOY REZHIM AKTIVNOGO ELEMENTA OKG KONECHNOY DLINY]
L. I. Kudryashev, L. I. Zhemkov, V. S. Vekshin, and B. R. Belostothkiy 30 Aug. 1967 8 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 5, no. 6, 1966 p 798-800
(FTD-HT-23-769-67; AD-671133)

The analysis of pulse-type operation proceeds from the physical character of the heat exchange and the geometry of the body. An equation describing the temperature fields in a circular cylinder of finite dimensions is obtained. An analysis is also made of the cooling phase of the operational cycle. An equation is derived to describe the temperature field with constant cycle duration and duty factor, for any number of successive cycles. The theoretical findings are applied to a real case of two cylindrical bodies, one with a length equal to its radius, the other with a length-to-radius ratio of 10:1; the results show a much weaker effect of the end surfaces in the latter case. TAB

N68-31458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PULSED ARGON ION LASER AT HIGH CURRENTS AND LOW PRESSURES [IMPUL'SNYY LAZER NA IONAKH Ar PRI BOL'SHIKH TOKAKH I NIZKIKH DAVLENIYAKH]
S. G. Kulagin, V. M. Likhachev, M. S. Ravinovich, and V. M. Sutovskiy 28 Jul. 1967 9 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 5, no. 4, 1966 p 534-536
(FTD-HT-67-448; AD-671137)

Oscillation of a pulsed Ar+ laser at heavy currents and low pressures was investigated experimentally. The heavy current pulsed discharge was achieved in quartz tubes 1000 mm long and 10 mm in (internal) diameter. The tubular electrodes, made of tantalum, were 50 mm long and 10 mm in diameter. The output of the gas-discharge chamber was directed through quartz plane-parallel plates situated 150 mm from the electrodes at Brewster angles. The cavity consisted of two spherical mirrors with a 300-mm radius of curvature, placed 1500 mm from each other. One mirror was silver coated and the other dielectric coated (reflectivities were 90 and 30%, respectively). The energy was supplied from condensers with capacities of 0.01, 0.1, 0.4, and 2.6 micro F at 10-25 kv. The equipment was capable of generating 1-15 kamp pulses for 1-5-microsec discharge periods. TAB

N68-31464# National Bureau of Standards, Washington, D. C.
RESEARCH ON LASER STANDARDS AND MATERIALS AT THE NATIONAL BUREAU OF STANDARDS
Karl G. Kessler, ed., Elio Passaglia, ed., and Nicholas N. Winogradoff, ed. Jun. 1968 32 p refs Sponsored by ARPA and AF
(NBS-TN-449) GPO: $0.30

Included in the report are the measurement of the power and energy output of lasers, their near and far field patterns and their optical properties. The physical and chemical properties of laser materials are studied in an attempt to relate such properties to the operating characteristics of lasers. Author

N68-31698# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
AN ESTIMATE OF THE ATMOSPHERIC PROPAGATION CHARACTERISTICS OF 1.54 MICRON LASER ENERGY
Rufus Bruce, James Mason, Kenneth White, and Richard B. Gomez Mar. 1968 44 p refs
(ECOM-5185; AD-670934)

Potential atmospheric effects on the propagation of electromagnetic radiation at 1.54 micron wavelength are examined. The results of transmission measurements by various investigators, as reported in the literature, coupled with theoretical calculations are applied to estimate the transmission characteristics for erbium ion (Er(+++)) laser radiation in this region. The output of the Er(+++) laser at 1.54 microns is discussed in some detail. Predominant attenuation mechanisms are found to be aerosol absorption and aerosol scattering. Contributions from five investigations of atmospheric transmission in this region are summarized. Nonlinear effects are not considered. Author (TAB)

N68-31757
SHIELDING OF A METAL SURFACE BY ITS RUPTURE PRODUCTS FROM LOW DENSITY LASER RADIATION FLUXES
G. S. Romanov and K. L. Stepanov [1968] 12 p refs Transl. into ENGLISH from Zh. Prikl. Spectry. (USSR), v. 8, no. 5, 1968 p 753–763
CFSTI: HC $3.00/MF $0.65

In considering questions associated with the phenomena of metal rupture under the effect of laser radiation, attention is focused on the attenuation of incident radiation on the ruptured surface because of its absorption by the rupture products; the influence of nonequilibrium ionization and population of the atomic levels on the absorption of radiation; and the conditions under which expansion of the material from the surface is adiabatic. The analysis is carried out at a constant radiation flux density in the 10^8 to 10^9 v/cm^2 range, when a stationary thermal rupture mechanism is valid, and the body surface temperature reaches a value of 10^3 to 10^4 °K. The material dispersion is assumed to be one-dimensional; the counter-pressure of the external medium is not considered. Author

N68-31760*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARTICIPATION OF AMES RESEARCH CENTER IN THE MSC-4 EXPERIMENT
Norman S. Johnson *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 1–7 (See N68-31759 19-07)

Discussed is the participation in a specific laser research project to determine whether the backscattered light from the turbulent region can be used to detect clear air turbulence. In support of this project, it is planned to compare the signal propagated from a ground station with that reflected from an earth-orbiting satellite with corner reflectors. The laser transmitter and receiver and the tracking equipment for receiving the laser signal to be transmitted by the astronaut from the Gemini 7 spacecraft are described. It is planned to locate the experimental equipment at Kauai, Hawaii. The objectives of the laser experiment are listed; they are intended to increase the probability of obtaining the basic data of the voice communication signal and, in addition, to obtain basic data on the effect of the atmosphere on the transmitted laser signal. The experimental setup, advantages of the Kauai location, and operational procedures are briefly discussed. K.W.

N68-31769*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MANNED SPACECRAFT CENTER LASER PROGRAMS AND PLANS
W. L. Thompson *In its* Proc. of the Space Opt. Tech Conf., Vol. 1 Apr. 1966 p 91–97 (See N68-31759 19-07)

Work in two areas of laser systems is discussed: Optical communications as applied to future manned deep space missions, and laser radar intended as a backup system for the X band Lunar Excursion Module (LEM) radar. In the deep space communication study, four major problem areas are defined: (1) acquisition and tracking of the very narrow beams; (2) prime power requirements for the relatively inefficient laser transmitter; (3) choice of optical modulator material and design to take full advantage of available bandwidths; and (4) atmospheric effects on a coherent beam. The emphasis in the study of the laser radar for use during rendezvous and docking of the LEM is on the change from semiconductor sources to solid state lasers. Described in this connection is the construction of an optical test tunnel for measuring reflectivity, absorption, scattering, dispersion, resolution, and system evaluation in the presence of background radiation. K.W.

N68-31941# California Univ., Berkeley. Lawrence Radiation Lab.
LASER INTERFEROMETER FOR MASS TRANSFER STUDIES
Kirk Watson Beach (M.S. Thesis) Feb. 1968 51 p refs
(Contract W-7405-ENG-48)
(UCRL-18037) CFSTI: HC $3.00/MF $0.65

A modified Mach–Zehnder interferometer with a He–Ne laser light source has been constructed for the study of mass transfer in a rectangular duct electrochemical reactor with forced and free convection. The Cu/$CuSO_4$/Cu reactor can be operated in both laminar and turbulent flow regimes with fully developed flow. The interferometer is capable of measuring concentration differences in $CuSO_4$ of 10^{-4} molar with a resolution of 0.005 mm in the direction perpendicular to the electrode at a rate of 64 frames/sec and an exposure time of 1/1000 sec. A set of expressions has been derived for the calculation of the error due to light deflection. The error has been found to be considerable in cases where linear concentration profiles with large gradients exist in wide cells. Author (NSA)

N68-32108# Battelle-Northwest, Richland, Wash. Theoretical Physics Section.
THE LASER ELECTRON ACCELERATOR AS A NEUTRON SOURCE
D. W. Glasgow Apr. 1968 37 p refs
(Contract AT(45-1)-1830)
(BNWL-684) CFSTI: HC $3.00/MF $0.65

An analysis was made of the feasibility of producing intense photoneutron sources by bombarding thick, heavy-metal targets with nuclear-pumped, laser-accelerated electrons. The maximum neutron yield per electron is obtained by bombarding thick lead or uranium targets with electrons of energy ≥100 MeV. There is a tendency for the photoneutrons to be focused in the forward direction at high electron energies. The neutron energy distribution is Maxwellian in shape with a pronounced high-energy tail. If the efficiency for converting energy from a 3000 MW reactor to accelerated electrons ≥1%, then source intensities ≥10^{17} n/sec are possible. A number of important physics experiments, now impossible or limited by neutron flux, are outlined which provide further justification for intense neutron sources. Author (NSA)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-30875 IIT Research Inst., Chicago, Ill.
EFFECTS OF STRAIN TEMPERING ON THE TOUGHNESS OF MARTENSITIC STEELS
Robert P. O'Shea (Ph.D. Thesis) 1967 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-13727

The influence of the mode of deformation or prestrain, the temperature of deformation, and retempering upon the toughness of quenched and tempered martensitic steel were investigated. In order to minimize the difficulties in analyzing the influence of the mode of deformation on impact properties, only uniaxial tensile and compressive plastic prestrains were examined. Charpy V-notch impact properties were compared for quenched and tempered martensitic steels which had been subjected to either room temperature deformation, room temperature deformation plus retempering, warm deformation or warm deformation plus retempering. In all cases, the working temperature and retempering temperature were below the initial tempering temperature. It is found that room temperature prestraining of approximately twenty percent of quenched and tempered martensite lowered the super shelf height of the Charpy V-notch impact curve from that of the as-heat treated curves. Dissert. Abstr.

N68-30927 Rice Univ., Houston, Tex.
SOME CONTRIBUTIONS TO THE THEORY AND APPLICATION OF DIFFUSE X-RAY DIFFRACTION FOR THE MEASUREMENT OF SHORT-RANGE-ORDER IN ALLOY SINGLE CRYSTALS
Toyoaki Ishibachi (Ph.D. Thesis) 1967 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13086

Improvements have been made in the method of determining the short range order in a binary alloy by diffuse X-ray diffraction measurements. It is shown that in a three dimensional measurement one can recover the first twenty Warren-order parameters from as few as twenty-four data points. It is also shown how one can correct for the error from the beam inclination due to the inadequate design of a monochrometer. A demonstration of these two improvements has been made for a Cu_3Au single crystal quenched from 450°C and 550°C. In addition an error in von Laue's expression for the diffuse intensity from a random alloy has been pointed out and the correct interpretation has been given. Also a criticism has been made of the Cowley and Christy-Hall approximation theories on order parameters, and of related papers. Dissert. Abstr.

N68-30942 Johns Hopkins University., Baltimore, Md.
THE APPLICABILITY OF THE GENERALIZED PARABOLIC DEFORMATION LAW TO A BINARY ALLOY
William Francis Hartman, Jr. 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13801

An experimental investigation of the deformation of annealed α-brass polycrystals, during both dynamic symmetrical free-flight impact and quasi-static tension and compression tests, demonstrates the applicability of Bell's generalized parabolic deformation law to a binary alloy. The dynamic experiments employ diffraction grating strain gages and the finite amplitude wave theory is found to be operative. Also, available single crystal deformation data for α-brass is found to agree with Bell's law through the Taylor aggregate theory. All of the finite deformations exhibit the discrete deformation phases and transitional behaviors predicted by Bell's generalization. Moreover, as has been found in other metals, small deformations of α-brass show multiple linear elastic regions, whose regional moduli are related in the same way as the finite deformation parabola coefficients and the discrete distribution of zero point isotropic infinitesimal shear moduli. Dissert Abstr.

N68-30963# Illinois Univ., Urbana. Dept. of Physics.
THIRD ORDER ELASTIC CONSTANTS OF ALUMINUM
Joseph F. Thomas, Jr. Feb. 1968 110 p refs
(Contract AT(11-1)-1198)
(COO-1198-500) CFSTI: HC $3.00/MF $0.65

The complete set of six third-order elastic constants of single-crystal Al has been experimentally determined by measuring both hydrostatic pressure and uniaxial stress derivatives of the natural sound velocities using a two-specimen interferometric technique. The values obtained are $C_{111} = -10.76$; $C_{112} = -3.15$; $C_{123} = +0.36$; $C_{144} = -0.23$; $C_{166} = -3.40$; and $C_{456} = -0.30$ in units of 10^{12} dyn cm^{-2}. The specimens were neutron irradiated to eliminate dislocation effects from the uniaxial experiments. A self-consistent set of hydrostatic pressure derivatives of the second-order elastic constants has been calculated from the measured third-order elastic constants. The third-order elastic constants have also been used to calculate the thermal expansion in the anisotropic continuum model at both high and low temperatures, and a comparison has been made to the directly measured expansion coefficients. The seven independent relations between second- and third-order elastic constants and appropriate lattice energy derivatives in a Fuchs approach have been obtained. The related deformation parameters have been described in a consistent fashion. The applicability of the Fuchs approach to elastic constant calculations for metal crystals has been discussed in terms of the neglect of energy terms which depend upon volume only. An attempt has been made to calculate the second- and third-order elastic constants of Al in a Fuchs approach using a Wigner–Seitz decomposition of the lattice energy. The terms considered were the electrostatic energy and the Fermi energy. The Fermi energy was treated in a nearly free-electron approximation. The fact that this attempt was unsuccessful has been attributed to the complicated energy band structure of Al in the vicinity of the Brillouin zone boundaries. Author (NSA)

N68-30957 Florida Univ., Gainesville.
ORDERING AND THE K-STATE IN NICKEL–MOLYBDENUM ALLOYS
Bruce Gordon Le Fevre (Ph.D. Thesis) 1966 239 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-12937

The K-state is a phenomenon that is marked by anomalous property changes in certain alloys without observable macroscopic structural changes. One of these anomalies is a decrease in resistivity with cold work and an increase in resistivity with annealing, an effect which is opposite to that found in normal alloys. Short-range order has frequently been suggested as a possible cause of the K-state. Studies were made on Ni–Mo to determine the role of short-range order on the formation of the K-state. Polycrystalline specimens containing 10.5, 14.0, and 20.0 a/o Mo were studied by means of electrical resistivity, X-ray diffuse scattering, electron transmission microscopy, field-ion microscopy, and X-ray small-angle scattering. These specimens were examined after a variety of mechanical and thermal treatments. Dissert. Abstr.

N68-30985# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
THE EFFECTS OF SILICA IN AUTOCLAVE TEST WATER ON THE STEAM CORROSION OF ZIRCALOY
E. J. Callahan and J. F. Kabat 30 Jan. 1968 15 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6748; EJC-10) CFSTI: HC $3.00/MF $0.65

XE-150 resin is used to deionize autoclave water. In the spent state, XE-150 resin releases silicate ion to the test water resulting in the accelerated corrosion of Zircaloy. At a silicon concentration of 1.12 ppM, the 14-day weight gains of sensitized Zircaloy in 750°F steam are effected. At a silicon concentration of 1.3 ppM, the 14-day weight gains of reactor-grade Zircaloy in 750°F steam are effected. Author (NSA)

N68-31002 California Inst. of Tech., Pasadena.
DISLOCATION VELOCITY AND SLIP ON THE $\{\bar{1}2\bar{1}2\}\langle 1\bar{2}13\rangle$ SYSTEMS OF ZINC
Richard Clark Blish, II (Ph.D. Thesis) 1967 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14362

Slip bands on the $\{\bar{1}2\bar{1}2\}\langle 1\bar{2}13\rangle$ systems of zinc were produced by stress pulses and were observed by etch pitting. Edge and screw dislocation velocities as a function of stress and temperature (77° to 323°K) were deduced by measurement of the size of the slip bands. For the low temperature range of 77° to 110°K it is found that dislocation velocity is proportional to (stress) $\exp(-U/kT)$ where $U = 0.182$ ev. Screw dislocation velocity is found to be larger than edge dislocation velocity at a constant stress. It is suggested that a Peierls mechanism controls the dislocation velocity for the low temperature range. Above 110°K the slip bands start to become wider as cross glide takes precedence over the Peierls mechanism for the limitation of dislocation velocity. It is found that dislocation velocity decreases and the amount of cross glide increases with increasing temperature. It is suggested that the dislocations are retarded by an increasing number of dragging dipoles. The experimentally measured dislocation velocities are also related to the macroscopic measurements of the yield stress and the work hardening coefficient. Dissert. Abstr.

N68-31055# Case Inst. of Tech., Cleveland, Ohio.
PRESSURE DERIVATIVES OF THE ELASTIC CONSTANTS OF RUBIDIUM
Lyle A. Pauer May 1968 38 p refs
(Contract Nonr-1141(05))
(TR-11; AD-670520)

The pressure variation of the elastic stiffnesses of rubidium was measured at 195K by the ultrasonic pulse echo method. The values found are: $dC44/dP = 1.48$; $dC'/dP = 0.229$; $dB_s/dP = 3.63$. The notation $C' = (C11-C12)/2$, $B_s = (C11+2C12)/3$ was used. The results were compared with the predictions of the Fuchs theory of the electrostatic contribution to the shear stiffnesses of the alkali metals. The experimental observation that the elastic anisotropy $C44/C'$ depends somewhat on pressure suggests the presence of another, minor, contribution to the shear stiffnesses, but the sense of the pressure dependence of $C44/C'$ is not accounted for by including an ion core interaction or a Fermi contribution. The bulk modulus and its pressure derivative are well described by the simplest model of the binding energy. The ultrasonic Murnaghan equation of state fits well the compression data of Swenson. Values of the temperature coefficients, at constant volume, of the elastic stiffnesses are presented. Author (TAB)

N68-31069# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
CORROSION AND HYDRIDING OF ZIRCALOY. TASK 2 TOPICAL REPORT: EFFECTS OF HYDROGEN AND PRECIPITATED HYDRIDES ON MECHANICAL PROPERTIES OF ZIRCALOY-4 Final Report
A. L. Lowe, Jr. and C. R. Johnson Mar. 1968 81 p refs
Sponsored by US-EURATOM
(Contract AT(30-1)-3765)
(BAW-3765-6; EURAEC-1954) CFSTI: HC $3.00/MF $0.65

A program was conducted to determine the tensile properties of Zircaloy-4 tubing containing up to 1000 ppM hydrogen over a temperature range from 70 to 800°F. Burst tests of hydrided material were included, but these were limited to room-temperature testing. Annealed and cold-worked material from the same lot of Zircaloy-4 tubing was tested. Tensile tests were performed at six different temperatures and six different hydrogen concentrations. The tensile-test results show that hydrogen has no significant effect on the tensile and yield strength of Zircaloy-4 over the 70° to 800°F temperature range. These results show that at operating temperatures, residual ductility measured by tensile elongation is consistently above 10% for cold-worked material containing as much as 1000 ppM hydrogen. NSA

N68-31085 Lehigh Univ., Bethlehem, Pa.
NUCLEATION AND GROWTH OF THE Pb-Sn EUTECTIC
Richard H. Hopkins (Ph.D. Thesis) 1967 122 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14938

The nucleation, solidification and crystallography of the Pb-Sn eutectic have been studied by X-ray and metallographic techniques. These studies reveal that a preferred orientation relation and interface plane between phases is developed as growth proceeds. The observed relationships rationalized in terms of an atomistic model of the interface are described. Controlled nucleation experiments employing single crystals of the nucleating phase (Sn) show that a lamellar structure immediately develops and continues to grow in vertically pulled specimens if the crystallographic direction coinciding with the seed axis lies in the lamellar plane. X-ray rocking curves obtained from horizontally grown and vertically grown seeded specimens indicate that the misorientation of the unit cells of the phases of the eutectic is essentially the same in both types of specimens after steady-state growth conditions are established. Berg-Barrett X-ray topographs on pulled specimens demonstrate that the perfection of these specimens increases as growth proceeds and is similar to that in horizontally grown specimens after steady-state growth conditions prevail. Considered together the data suggests that the finally observed eutectic microstructure, crystallography and perfection are developed by the process of preferred eutectic grain growth. Dissert. Abstr.

N68-31132 Illinois Univ., Urbana.
METALLURGICAL STUDIES OF FATIGUE DAMAGE IN MARAGING STEEL
Robert William Hinton (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-11866

The fatigue damage of a high strength 12% nickel maraging steel was observed in terms of the changes in stress range and substructure with the amount of cyclic deformation at a constant strain range. Tests in low cycle fatigue were performed on samples of solution treated and of aged 12% nickel maraging steel at room temperature and above and below room temperature. Failures occurred after 40 to 70,000 cycles for the strain ranges investigated. Polished samples with a minimum diameter resulting from their "hourglass shape" were tested in fatigue by the application of axial stresses determined by the constant strain range for each cycle with a mean strain range of zero. The change in stress range due to fatigue was resolved into two components of stress which were found to be functions of the number of applied cycles of fatigue. Cyclic hardening was related to point defect hardening from the observations made in this investigation as related to a previous investigation of LiF. The fatigue behavior in terms of cyclic softening and cyclic hardening was the same for both the solution treated and the aged 12% nickel maraging steel. A predicted fatigue diagram was constructed for the maraging steel by assuming a constant magnitude of the stress range due to cyclic hardening at failure. Dissert Abstr.

N68-31133 Illinois Univ., Urbana.
STAGE 3 ANNEALING STUDY OF ELECTRON-IRRADIATED ALUMINUM AND DILUTE ALUMINUM ALLOYS
Yan Naing Lwin (Ph.D. Thesis) 1967 188 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-11881

Zone-refined Al and Al-Mg, Al-Ag, Al-Au, Al-In and Al-Zn alloys were irradiated with 2 MeV electrons near 80°K. The highest integrated flux of 6.8×10^{18} e/cm^2 produced a resistivity increase of $2.46\times10-9\Omega$ cm in high purity Al specimen. The enhancement of production was observed for Al+Ag and Al+Mg alloys, but not for the other alloys. Isochronal annealing measurements were made in the region from −130°C to 20°C for pure Al and Al alloys. Some of the specimens were isothermally annealed in steps of 20°C for 64 minutes at each temperature from −130°C to 75°C. The main Stage III peak in pure Al was centered about −45°C, and two small recovery peaks were found in the low-temperature side of the main Stage III peak. The alloys also showed three distinct peaks as was in pure Al. Existing models that had been suggested to explain the annealing of Stage III are discussed. Dissert. Abstr.

N68-31137 Rensselaer Polytechnic Inst., Troy, N. J.
ELECTROCHEMICAL CORROSION PROPERTIES OF IRON AND STEEL
Harold Joseph Cleary (Ph.D. Thesis) 1967 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-12833

Multiple correlation analysis of corrosion rates for carbon and low alloy steels in 0.1N H_2SO_4 allows prediction of the corrosion rate for any alloy within the composition limits of the analysis. The presence of phosphorus and carbon is especially detrimental to corrosion resistance. The effect of manganese is complex; when present in large amounts this element also lowers resistance. Copper is mildly beneficial; silicon lowers resistance slightly; while sulphur, chromium and nickel have no effect on behavior. The corrosion rate is markedly dependent on the distribution of iron carbide in the microstructure; decreased average pearlite lamellae spacing, for example, is accompanied by increased dissolution rate. Dissert. Abstr.

N68-31247# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Studiecentrum voor Kernenergie.
IN-PILE CORROSION OF NUCLEAR MATERIALS Final Report
[1968] 73 p refs Sponsored jointly by US-EURATOM (Contract Euratom-055-65-3-TEEB)
(EURAEC-2010; EUR-3796; R.2443) CFSTI: HC $3.00/MF $0.65

Electrochemical corrosion tests were carried out on stainless steels, Al, and Pt under in-pile and out-of-pile irradiated solution conditions. The irradiations used in neutron flux of $>10^{12}$ nv and a gamma flux of $>5\times10^5$ R/hr. The results confirm the hypothesis that the corrosion behavior is determined largely by radiolytic effects in the solutions. The action of radiation is similar to other means of provoking passivity, activation, or pitting. It is suggested that a Pt or steel electrode be used as a corrosion monitor in irradiated aqueous media. NSA

N68-31304# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
READILY AVAILABLE HYDROGEN-RESISTANT STEEL [MALODEFITSITNYE VODORODOUSTOICHIVYE STALI]
I. D. Grebeshkova Sep. 1967 37 p refs Transl. into ENGLISH from Novye Materialy v Mashinostr. (Moscow), 1964 p 19–43
(FTD-MT-66-143; AD-671144)

The influence of alloying elements on the hydrogen resistance of steel was investigated on specimens subjected to hydrogen at various pressures at 600C, and for various test durations. Mechanical tests performed before and after heating in hydrogen showed the corresponding changes in physical properties. Four series of tests were carried out: (1) variation of the chromium content in chromium steels (hydrogen pressure 400--800 kg/sq cm for 1000--4000 hours); (2) variation of the tungsten, columbium, vanadium and titanium content (800 kg/sq cm; 1000 hours); (3) variation of the molybdenum, tungsten, columbium, vanadium, and titanium content in steel with 0.2% C, 3% Cr (400--750 kg/sq cm; 1000--2000 hours); (4) variation of the silicon, molybdenum, tungsten, vanadium, and titanium content in steel with 0.2% C, 6% Cr (800 kg/sq cm; 4000 hours). From the obtained test results it is concluded that the hydrogen resistance of steel is determined mainly by the type of carbide phase, the character of the interatomic ties between carbon and the alloying element, and secondarily by the velocity of carbon diffusion in chromium-containing ferrite. Tests showed that additions of Cr, Mo, W, V, Cb, and Ti increase the stability of the carbide phase; at the same time, the velocity of carbide phase coagulation decreases. The degree of dispersion of the carbide component is apparently not important. To stabilize steel with 0.2% C, 3-6% Cr against hydrogen corrosion (at 600C), the addition of stronger carbide-forming elements such as V, Cb, and Ti, or the addition of more than 9% Cr, is required. Author (TAB)

N68-31312# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIATION IN THE PROPERTIES OF A NICKEL-BASE FOUNDRY ALLOY SUBJECTED TO ELECTROSLAG REMELTING [IZMENENIYE SVOYSTV LITEYNOGO SPLAVA NA NIKELEVOY OSNOVE PRI ELEKTROSHLAKOVOM PEREPLAVE]
R. P. Zaletayeva 20 Oct. 1967 10 p Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Tekhnol. i Mashinostr. (Moscow), v. 105, 1962 p 184–189
(FTD-HT-67-377; AD-670904)

In the electroslag remelting method, metal smelted in a regular furnace is cast as a bar, then is remelted in a special installation in such a way that a portion of the liquid remelt, passing through a layer of a special flux at high temp., comes to a crystg. app. and solidifies with practically no contact with air. CaF2 was used as the flux in the remelting. At room temp., the plastic

properties (elongation and shock resistance) improved 3-3.5 times and the redn. of area increased by 25-30%, with some improvement of short-term strength characteristics; at 800 degrees the gain in plasticity in electroslag remelting remains the same as at 20 degrees, with practically equal strength. The electroslag remelting substantially improves the continuous strength of a cast alloy in the range of high stresses and short service time, and is impracticable when the metal is used for work at relatively light stresses, but for long duration (>1500 hrs.). Electroslag remelting, bettering the state of grain boundaries of an alloy and considerably improving its plasticity, makes possible the forging of an expti. alloy, while in the case of the usual smelting the alloy breaks with the first strokes of the hammer. Author (TAB)

N68-31314# Bureau of Reclamation, Denver, Colo. Chemical Engineering Branch.
A SUGGESTED METALLURGICAL PARAMETER IN ALLOY SELECTION FOR CAVITATION RESISTANCE
T. E. Backstrom Dec. 1967 41 p refs
(CHE-72; PB-177826) CFSTI: HC$3.00/MF$0.65

A brief review of the state of the art is given regarding parameters for alloy selection for cavitation resistance. Elastic-plastic strain energy, a new parameter derivable from an engineering stress-strain curve, is proposed. The proposed parameter is shown to correlate well with observed cavitation resistances of the alloys tested. Several occurrences and observations from cavitation studies described by other investigators can be explained in light of elastic-plastic strain energies and cavitation shock wave intensities. USGRDR

N68-31338 Pennsylvania Univ., Philadelphia.
THE EFFECTS OF IRRADIATION ON PHASE TRANSFORMATIONS IN THE Al RICH-Cu SYSTEM
Lewis Emanuel Katz 1967 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-12764

An investigation has been carried out on the effects of high energy irradiation on decomposition of supersaturated Al rich-Cu alloys. Samples in the reverted condition were irradiated with deuterons, and both quenched and reverted samples were irradiated with neutrons with doses up to $1.2\times10^{17}n/cm^2$. Highdose neutron irradiations were performed on quenched 4% alloys which were subsequently aged to bring out θ'. Deuteron and neutron irradiations near liquid nitrogen temperature of reverted samples resulted in no apparent enhanced rate of nucleation of G.P.I. An acceleration of precipitate formation is observed in the 1% alloy, though this effect saturates at low doses ($1.8\times10^{14}n/cm^2$). A model has been formulated to explain the results. High-dose neutron experiments result in precipitate (θ') formation in the 4% alloy. Calorimetric experiments were carried out to detect any enhanced energy release during zone formation in an irradiated alloy. It is concluded that if any enhanced energy release is occurring, it is less than the sensitivity of the instrument. It is concluded that the precipitation of heterogeneously nucleated precipitates (θ') can be enhanced by neutron irradiation. Dissert. Abstr.

N68-31435*# Arde-Portland, Inc., Paramus, N. J.
GOLD BRAZE INVESTIGATION AS APPLICABLE TO MULTICYCLE METALLIC REVERSING BLADDERS
15 May 1968 26 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951898)
(NASA-CR-95986; Rept.-56001-I) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A program was undertaken to establish the technology necessary to utilize a gold alloy as the braze material in the fabrication of an 18" diameter, wire reinforced multicycle stainless steel reversing bladder. A literature survey was conducted, flat plate specimens were fabricated and tested, as were two (2) 11.5 inch diameter bladder structural models. The ARDE gold braze evaluation program was conducted in conjunction with a propellant compatibility screening evaluation as the Jet Propulsion Laboratory. The results of the braze evaluation program showed that structurally adequate brazed joints between reinforcing wires and bladder shell can be made utilizing gold brazing alloys compatible with the projected propellants (N_2O_4 and N_2H_4). Author

N68-31517*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
STRESS-STRAIN BEHAVIOR OF COLD-WELDED COPPER-COPPER MICROJUNCTIONS IN VACUUM AS DETERMINED FROM ELECTRICAL RESISTANCE MEASUREMENTS
John S. Przybyszewski Washington Aug. 1968 22 p refs
(NASA-TN-D-4743) CFSTI: HC$3.00/MF$0.65 CSCL 11F

True stress-strain curves, developed from contact-resistance measurements between two OFHC copper specimens loaded and unloaded in vacuum, showed that the cold-welded junctions exhibited an amount of ductility generally characteristic of the specimen material. Junction ductility was greater when the experiment was kept vibration free. Deliberate vibration introduced during the loading cycle lowered the junction ductility. The contact-resistance-against-load data also seemed to indicate that impulsive forces could increase the area of contact under fixed load to a point where the contact area might revert to an elastic condition. Author

N68-31549# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
SOME TESTS ON THE EFFECT OF THE ENVIRONMENT OF THE PROPAGATION OF FATIGUE CRACKS IN ALUMINUM ALLOYS
A. Hartman, F. A. Jacobs, A. Nederveen, and P. de Rijk May 1967 87 p refs Prepared for the Neth. Aircraft Develop. Board
(NLR-TN-M.2182) CFSTI: HC$3.00/MF$0.65

The investigation comprised four parts: 1) Tests to determine the combined effects of the humidity of the air and the load frequency (clad 2024-T3 and 7075-T6). 2) Tests to determine the effect of water. 3) Tests to determine the effect of wetting with a water displacing oil. 4) Tests to determine the effect of humidity of the air in two step tests. The latter three types of tests were carried out at a high frequency of loading and were performed on 2024-T3 Alclad only. The effect of the environment on fatigue crack propagation is analyzed. Author (ESRO)

N68-31560# Lockheed-Georgia Co., Marietta. Materials Sciences Lab.
MECHANISM OF SUPERPLASTICITY IN AL-78% ZN ALLOYS Annual Interim Summary Report No. 1, 20 Jun. 1967-30 Jun. 1968
Ervin E. Underwood, F. D. Fike, H. H. Kronzlein, E. U. Lee, and H. J. Rock 30 Jun. 1968 56 p refs
(Contract N00014-67-C-0503)
(AD-670800)

Superplasticity has been studied in the Al-78%Zn alloy with the purpose of identifying the basic mechanisms that control this unusual process. The experimental investigation has systematically covered the mechanical and microstructural relationships over a range of temperatures and strain rates, for different heat-treatments. Replication, electron microscopy, and selected area diffraction have been combined to relate the prior history of the alloy, its microstructure, and the nature of its defects. Moreover, through cinematography, such mechanisms as grain boundary sliding, grain rotation, and profuse dislocation generation are shown to occur during the actual process of superplasticity. The important

experimental observations are discussed, and it is concluded that superplastic deformation in the Al-78%Zn alloy consists of grain boundary sliding, diffusional creep along grain boundaries, and dynamical interactions of dislocation. Author (TAB)

N68-31576# British Iron and Steel Research Association, London (England). Metallurgy Div.
ANALYSIS OF HIGHLY ALLOYED STEELS BY X-RAY FLUORESCENCE SPECTROMETRY
D. F. Sermin [1967] 19 p
(MG/D-201/62) CFSTI: HC $3.00/MF $0.65

Experiments were carried out in order to assess the potentialities of x-ray spectrometry for the analysis of highly alloyed steels. A study was made of the effects of possible instrumental errors that may affect the analytical accuracy. Methods of effectively reducing these were considered. It was concluded that x-ray fluorescence spectrometry is both a rapid and accurate method for the analysis of highly alloyed steels for the elements Cr, Mn, Ni, Mo, Ti, and Nb. Inter-element effects were found to be of a very systematic and predictable nature. NSA

N68-31596# Union Carbide Corp., Kokomo, Ind. Materials Systems Div.
HAYNES ALLOY NO. 188—A NEW OXIDATION RESISTANT, HIGH STRENGTH, DUCTILE, COBALT BASE ALLOY
R. B. Herchenroeder [1967] 19 p Presented at the Fall Meeting of the Metallurgical Society of AIME, Cleveland, 17 Oct. 1967

A cobalt-base alloy, designated Haynes developmental alloy no. 188, displayed good oxidation resistance at temperatures through 2000°F as well as high strength characteristics. The newly-developed alloy has good postaging and annealed ductility, metallurgical stability, and repair weldability. Chemical composition by weight percent is Cr 22, Ni 22, W 14, Fe 1.5, Mn 0.75, Si 0.20, C 0.08, and La 0.08. Cobalt content is 39.39 wt %. M.W.R.

N68-31605*# National Aeronautics and Space Administration, Washington, D. C.
EFFECTS OF LOW TEMPERATURES ON THE MECHANICAL PROPERTIES OF STRUCTURAL METALS
H. L. Martin, P. C. Miller, A. G. Imgram, (Battelle Mem. Inst., Columbus) and J. E. Campbell (Battelle Mem. Inst., Columbus) 1968 65 p refs Revised
(NASA-SP-5012(01)) GPO: HC $0.50; CFSTI: MF $0.65 CSCL 11F

Industrial applications in aerospace and other fields are noted for cryogenic technology; and mechanical properties of metals at low temperatures are discussed in terms of alloying and welding effects and the fracture of preexisting flaws and notches. Testing procedures are outlined; and data are presented for aluminum, magnesium, nickel, steel, and titanium alloys. Tensile properties are tabulated for a wide variety of these alloys in base and welded forms. Studies indicate that the austenitic stainless steels retain high ductility and toughness at temperatures as low as −423°F. Higher strength with good toughness as low as −320°F can be provided with 9Ni-4Co steels. Use of various aluminum alloys is cited, and toughness values of certain age-hardened Al alloys are found to be marginal at low temperatures. High strength, low density, and corrosion resistance of titanium alloys are noted; as are the high ductilities of nickel alloys. Developments in gas liquefaction and separation, storage and handling of cryogenic fluids, low temperature heat exchange, quick freezing, superconductivity, and low temperature storage and surgical techniques are covered. M.W.R.

N68-31628# National Engineering Lab., Glasgow (Scotland). Materials Group.
A FEASIBILITY STUDY ON COLD EXTRUDING CAST IRON
E. Whitfield Jan. 1967 23 p refs
(NEL-266) CFSTI: HC $3.00/MF $0.65

Details are given of limited exploratory tests on the cold extrusion of cast iron using copper-plated billets and billets provided with a thick cladding of copper. It was found that copper-plated billets of nodular cast iron in the annealed condition could be cold extruded satisfactorily into rods over a wide range of extrusion ratios, but into cans at only the lower extrusion ratios. Only partial success was achieved in the cold extrusion of grey cast iron in the annealed condition and then only if the billets were protected by a thick cladding of copper. Extrusion was more successful when the cladding was on the circumference and the leading end then when it was on the circumference only. Author

N68-31638# Aerojet-General Nucleonics, San Ramon, Calif.
EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING Quarterly Progress Report, Oct. 1–Dec. 31, 1967
Feb. 1968 29 p (Contract AT(04-3)-368)
(AGN-8265) CFSTI: HC $3.00/MF $0.65

Creep testing of Hastelloy X in argon at 1300° and 1400°F is described. Data indicating structural changes are presented. NSA

N68-31668# Argonne National Lab., Ill.
RADIOGRAPHIC INVESTIGATION OF THE $\alpha \rightleftarrows \delta$ TRANSFORMATION OF PURE URANIUM
J. Eisenblaetter, G. Haase, and F. Granzer [1968] 16 p refs Transl. into ENGLISH from J. Nucl. Mater., v. 21, 1966 p 53–60
(ANL-TRANS-601) CFSTI: HC $3.00/MF $0.65

The $\alpha \rightleftarrows \delta$ transformation of pure U was investigated by x-ray diffractometry in conjunction with a high-temperature chamber. In contrast with techniques hitherto adopted (metallography, dilatometry, and electrical resistivity) this method permits direct observations of grain size and orientation in the δ phase at the transformation temperature. The transformation mechanism was examined by two principal methods. (1) After each successive transformation cycle an examination was made to identify the observable diffraction lines of both phases and their intensities. (2) The counter was locked on a particular line and intensity/time plots were recorded during transformation. The results were compared with current theories of this transformation. Author (NSA)

N68-31672# Martin Co., Denver, Colo. Research Dept.
THE EFFECT OF SURFACE ON FATIGUE RESISTANCE AND BRITTLE FRACTURE Final Report, Jan.–Dec. 1967
I. R. Kramer Wright-Patterson AFB, Ohio Mater. Lab., AFSC Mar. 1968 52 p refs
(Contract F33615-67-C-1297)
(MCR-67-421; AFML-TR-68-65; AD-670598)

The role of the surface layer stress on polycrystalline aluminum specimens subjected to four types of cyclic loading was investigated. The data show that when a specimen is subjected to cyclic tension-tension forces the cyclic creep can be accounted for by a relaxation of the surface layer stress. The relaxation of the surface layer stress causes the specimen to flow plastically at a stress less than the applied maximum stress. Thus, plastic flow occurs at each stress cycle until the specimen fractures. In a similar manner the decrease in the surface layer stress can account for the work softening when prestrained specimens are cycled in tension-compression, and when specimens are cycled in tension-tension to a fixed strain limit. For annealed specimens cycled between fixed strain limits in tension-compression, the increase in the applied stress was found to be equal to the increase in the surface layer stress. The surface layer was found to be important in brittle fracture. A decrease in the surface layer stress by electrochemical removal of metal decreased the ductile-brittle transition temperature by 15 degrees C. Author (TAB)

N68-31701# Acta Polytechnica Scandinavica, Stockholm (Sweden).
CARBON STRENGTHENING OF MARTENSITE IN RELATION TO THERMALLY ACTIVATED DEFORMATION
O. Krister Kallstrom 1967 29 p refs
(APS-CH-65; PB-177683) CFSTI: HC$3.00/MF$0.65

The flow stress of iron-carbon martensite, both as untempered and tempered, is measured in compression as a function of temperature and strain rate, and the activation energy of the deformation is calculated according to a technique developed by Conrad. From a comparison with his results on ferrite it is concluded, that Peierls–Nabarro barriers are thermal obstacles in well tempered martensite as well as in ferrite. In untempered martensite the activation energy is considerably lower, and it is argued that here the thermal obstacles consist of single carbon interstitials. At room temperature thermal fluctuations will fully assist the dislocations in overcoming these obstacles and, consequently, single interstitials will have no effect on the flow stress at this temperature. Instead the dominant part of the flow stress at room temperature is considered to be due to athermal obstacles which are thought to consist of couples and larger groups of carbon atoms on adjacent lattice sites. Such obstacles would explain the dependence of flow stress carbon concentration. Author (USGRDR)

N68-31706# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
A STUDY OF BORON SEGREGATION IN BORON-STAINLESS STEEL ALLOY
R. F. Dufour 12 Sep. 1967 12 p ref
(Contract W-31-109-ENG-52)
(KAPL-M-6731) CFSTI: HC$3.00/MF$0.65

Boron—stainless steel from one material supplier was studied in order to determine the extent of boron variability at various stages of the manufacturing process. This investigation examined three phases of the manufacturing process; the ingot, the billet, and the finished wire. The distribution of boron, which was found in the alloy from the particular supplier studied, happened to be greatest in the radial direction—as much as 20% variability from center of billet to edge. The degree of boron variability which was found does show that manufacturing processes can be responsible for differences which exceed present specification requirements. This study also points out that a need exists for closer attention to product sampling techniques. Author (NSA)

N68-31753# National Bureau of Standards, Washington, D. C. Corrosion Section.
MICROBIAL CORROSION Technical Summary Report, 1 May 1967–30 Apr. 1968
Warren P. Iverson 30 Apr. 1968 48 p refs
(Contract NAONR-14-67)
(NBS-9846; TSR-1; AD-670501)

Studies of the effect of microorganisms, particularly sulfate reducers (Desulfovibrio), on marine corrosion were initiated. The inability of sulfate reducers to grow on the agar surface of media appears to be due to the presence of the ferrous salt used as an indicator for hydrogen sulfide. Evidence indicates that phosphate may be an electron acceptor in the cathodic depolarization of steel. Iron phosphide and vivianite were produced by Desulfovibrio growing in contact with mild steel. The organism reduces phosphate in the presence of hydrogen to form a volatile phosphorous containing compound which is not phosphine. Light increases the corrosion rate of steel as indicated by polarization measurements. The cathodic protection currents required to maintain a potential of 0.8 volts on a steel specimen in indirect sunlight was found to be 1.5 times that required in the dark. Author (TAB)

N68-31779# Army Materials and Mechanics Research Center, Watertown, Mass. Metals Lab.
ELASTICITY OF TITANIUM SHEET ALLOYS
Anthone Zarkades and Frank R. Larson May 1968 19 p refs
(AMMRC-TR-68-10; AD-670938)

This report is based upon results from a program in which strain gage measurements were made of the elastic properties on various sheet titanium alloys. Methods for computing polycrystalline elastic properties from single crystal values were reviewed and these calculated curves were then compared to the actual test results. It was observed that the anisotropic variations in elastic properties of titanium and its alloys depend upon two factors. The first is the basic elastic anisotropic characteristics of the titanium single crystal, and the second is the intense preferred orientations commonly found in the wrought products. It was also established that moderately accurate predictions of elastic anisotropy can be made for polycrystalline aggregates with elementary textures and that the constant stress model is adequate for describing the behavior patterns found in titanium sheet material. Author (TAB)

N68-31796# Massachusetts Inst. of Tech., Cambridge. Casting and Solidification Section.
DEVELOPMENT OF HIGH STRENGTH WROUGHT ALUMINUM BASE ALLOYS Annual Report, Jun. 1966–Jun. 1967
S. N. Singh, T. F. Bower, and M. C. Flemings Jun. 1967 126 p refs
(Contract DA-19-020-ORD-5706(A))
(AD-670979)

Work is reported on small-scale laboratory techniques for development of high strength wrought aluminum alloys, and on structure and properties of alloys produced. Highest tensile strengths obtained were in excess of 115,000 psi; highest yield strengths were in excess of 110,000 psi. Four different alloys tested showed yield strengths in excess of 90,000 psi with elongations in excess of 5%. All testing was on flat specimens machined from rolled sheet. The sheet was produced from cast ingots. The ingots employed as starting material were thin section rapidly solidified plates. The rapid solidification produced a dendrite arm spacing that was sufficiently fine (approximately 8 microns) that complete homogenization was feasible in a reasonable time. Plates were fully homogenized before rolling. In initial stages of the alloy development, a levitation melting and splat cooling device was used to permit rapid determination of (1) maximum alloy contents that could be employed while still retaining a single phase at solution temperature, and (2) optimum solution treatment temperature. Dendrite arm spacing in these splats was 1-2 microns. Author (TAB)

N68-31850# Aeronautical Research Labs., Melbourne (Australia).
THE SUPERPLASTIC BEHAVIOR OF THE ALUMINUM-ZINC EUTECTOID
A. Ball and M. M. Hutchison Dec. 1967 36 p refs
(ARL/MET-70) CFSTI: HC$3.00/MF$0.65

It is shown that superplastic extension of the Al-Zn eutectoid results from extensive grain boundary sliding and grain rotation. The relationship between strain rate, flow stress, grain size and temperature can be described by equation. A model is proposed in which small groups of grains, by reason of the orientation or alignment of their boundaries, coordinate their movement by sliding at these boundaries. However, the motion of such groups of grains is restricted by the necessity to deform obstructing grains. The equation and the electron microscopy observations are discussed in terms of a mechanism involving the generation and motion of dislocations in obstructing grains. These dislocations pile up at the opposite grain boundaries until their back stress prevents further sliding of the groups of grains. However, under super-plastic conditions, dislocations escape from the heat of the pile-up by grain boundary diffusion, the rate of which is accelerated by the concentrated stress from the pile-up. As dislocations escape, the back stress decreases and further sliding occurs. The amount and rate of this sliding are thus controlled by the accelerated diffusion rate. Author

N68-31873# Massachusetts Inst. of Tech., Cambridge.
METALLURGICAL STRUCTURE AND THE BRITTLE BEHAVIOR OF STEEL Final Report
Morris Cohen May 1968 32 p refs
(Contract NObs-88279)
(SSC-183; AD-670574)

By means of surface-replication and three-dimensional metallography, it has become possible to delineate the interrelated processes of slip, twinning, carbide cracking, void formation and microcleavage in the tensile testing of iron and mild steels at subatmospheric temperatures. The cracking of intergranular carbides is an especially potent means of microcleavage initiation, and can be used as a tell-tale to follow the fracturing sequences. There are indications that the amount and size of intergranular carbides in mild steels are reduced by decreased carbon content, increased manganese content, increased cooling rate from the austenitizing temperature, and decreased grain size. The initiation of microcleavage via carbide cracking can be treated statistically, on the assumption that the number of carbide cracks per unit volume is proportional to the plastic strain, and that the size distribution of carbide cracks at any given strain is parabolic up to the maximum size present.
Author (TAB)

N68-31981*# Institute of Modern Languages, Inc., Washington, D. C.
STRENGTH OF NICKEL AND IRON FILMS OBTAINED BY VACUUM CONDENSATION [O PROCHNOSTI PLENOK NIKELYA I ZHELESA POLUCHENNYKH KONDENSATSIYEY V VAKUUME]
L. S. Palatnik, A. I. Il'insky, and A. G. Ravlik NASA Jul. 1968 4 p refs Transl. into ENGLISH from Fiz. Metal. i Metal. Metalloved. (USSR), v. 19, 1965 p 310–311
(Contract NASw-1693)
(NASA-TT-F-11447) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Tests were conducted on 20 ± 5-μ-thick nickel and iron films prepared by vaporization in vacuum and deposition by condensation, at a rate of 0.2–0.3 μ/min, of metals of 99.99 and 99.9% purity. The tensile strength and microhardness of the films are measured and diagrammed. Nickel films, in contrast to copper and silver films, are found to exhibit a marked long-time stability at room temperature.
Author

N68-31988# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REACTION OF MOLYBDENUM WITH TITANIUM CARBIDE [VZAIMODEISTVIE MOLIBDENA S KARBIDOM TITANA]
V. N. Yeremenko and T. Ya. Velikanova 26 Sep. 1967 13 p refs Transl. into ENGLISH from the book "Vysokotemperaturnyye Neorganicheskiye Soedineniya" Kiev, Izd. Naukova Dumka, 1965 p 265–273
(FTD-HT-23-516-67; AD-670898)

Interaction between molybdenum and titanium carbide in the 1.2-90 mol % TiC range was investigated by x-ray and metallographic techniques. Samples of Mo-TiC in various ratios were prepared by prolonged melting technique as well as by fusion in vacuo of mixtures of TiC with Mo at 1850-2000C. The oxygen was removed from the samples by reduction with hydrogen at 1000C. It was found that the Mo-TiC system is quasibinary and exhibits a eutectic type crystallization pattern. The eutectic temperature is 2175 plus or minus 15C. The solubility of Mo in TiC at the eutectic temperature is 37 mol % and at 2000C it is 25 mol %. The solubility of TiC in Mo at the eutectic temperature is within the 3.5-4.5 mol % range and at 2000C it falls within the 2-2.5 mol % range. The temperature dependence of the thermodynamic activity of carbon in TiC and Mo2C is shown. A phase diagram of the quasibinary Mo-TiC system is also given.
Author (TAB)

N68-31987# Aeronautical Research Labs., Melbourne (Australia).
VARIATIONS IN FATIGUE PROPERTIES BETWEEN BATCHES OF D.T.D. 363A ALUMINIUM ALLOY
J. Y. Mann and A. Vann Dec. 1967 13 p refs
(ARL/SM-321) CFSTI: HC$3.00/MF$0.65

A rotating cantilever fatigue investigation has been carried out on unnotched and notched specimens (K_t = 2-3 and 4-9) of D.T.D. 363A (D.T.D. 5064) aluminium alloy taken from material having average ultimate tensile strengths of 78,200, 88,000 and 92,100 p.s.i. In all cases the respective fatigue strengths reflected the differences in U.T.S. between the various batches, and it is therefore concluded that the order of the U.T.S. for various batches of an alloy may be a useful guide in selecting the batch of highest fatigue strength.
Author

N68-32031# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CORROSIVE INFLUENCE OF DIPHENYL ON METALS AND OXIDES [KORROZIONNOYE VOZDEYSTVIYE DIFENILA NA METALLY I OKISLY]
Yu. F. Bychkov, I. D. Laptev, and A. N. Rozanov 12 Sep. 1967 21 p refs Transl. into ENGLISH from the book "Issledovaniya po Primeneniyu Organicheskikh Teplonositeley Zamedliteley v Energeticheskikh Reaktorakh" Moscow, Gos. Kom. po Ispol'z. At. Energii SSSR, 1964 p 151–163
(FTD-MT-66-123; AD-670944)

An investigation was made of the transformations which can occur with reactor materials exposed to biphenyl and evaluated the effect of such factors as the presence of admixtures and the degree of pyrolytic decomposition. The hydride mechanism of corrosion was investigated first with respect to uranium and its alloys with molybdenum. The corrosion tests with biphenyl were carried out in containers made of 1Kh18N9T stainless steel. The changes undergone by a variety of metals, alloys and oxides are tabulated. Also investigated was the effect of admixtures of water (0.0004-0.7 wt.%) and sulfur (1-3 wt.%) in biphenyl on its corrosive properties. The results indicate that metals and oxides are subject to the following types of transformations in biphenyl: reduction of oxides and hydroxides to the metal or another oxide; formation of hydrides; formation of carbides; and oxidation. Admixture of water to biphenyl in amounts greater than 0.2% was shown to hasten the corrosive failure of aluminum A-1 and SAP-1 alloy and lead to intercrystalline corrosion, as well as embrittling and lowering the strength of the metals. Corrosion was also accelerated by sulfur. Admixtures of water do not affect SAP-1 alloy as much as aluminum AD-1.
Author (TAB)

N68-32041# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
METALLOGRAPHIC PREPARATION OF HOLMIUM
Anna G. Dobbins 28 May 1968 14 p refs
(Contract W-7405-ENG-26)
(Y-1618) CFSTI: HC$3.00/MF$0.65

Cathodic etching of holmium metal under an argon atmosphere produced a structure that was essentially identical in major details to that produced by careful hand polishing or chemical polishing. In addition, the surface produced was relatively reaction free.
Author (NSA)

N68-32052*# Merrick Engineering, Inc., Nashville, Tenn.
DEVELOPMENT OF WELD INTELLIGENCE SYSTEM AND CONTROLS Final Report
George E. Cook Aug. 1967 289 p refs
(Contract NAS-8-11808)
(NASA-CR-61921) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The objective was to improve the properties of 2219 aluminum weldments by adaptively controlling the workpiece temperature in the

vicinity of the molten puddle. Constraints were: (1) the transducer had to be of the temperature sensing type capable of providing intelligence related to the heat pattern about the molten puddle, (2) emphasis would be placed on transducers operating from the arc side of the workpiece, (3) all experimentation would be conducted with the gas tungsten arc process, and (4) the transducer had to be of such size and shape as not to obstruct the welding operation. A hybrid thermocouple probe assembly was designed and fabricated to provide an accurate and simple method of monitoring workpiece temperature during the welding process. The system was demonstrated to be insensitive to radiated arc interference and the effect of variations in surface emissivity, provide an essentially instantaneous response, and be free from interference due to surface oxides. An adaptive controller was designed and fabricated to amplify the hybrid thermocouple signal and actuate a small instrument servomotor, which was geared to a potentiometer for varying either the travel speed or weld current. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-30880# Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux

THE INFLUENCE OF GRAFTING ON THE CHARACTERISTICS OF UNSATURATED POLYESTER-STYRENE COPOLYMERS [INFLUENCE DE LA RETICULATION SUR LES PROPRIETES DES COPOLYMERES POLYESTERS INSATURES-STYROLENE]

Jacques Bonnet, Bernard Persoz, and Jean-Claude Rosso 1968 10 p refs In FRENCH; ENGLISH summary Published in Peintures Pigments-Vernis, Vol. 44, No. 3, Mar. 1968
(ONERA-TP-558) CFSTI: HC $3.00/MF $0.65

The experiments were carried out on series of unsaturated polyester-styrene copolymers the grafting of which was controlled by working on the proportion of saturated and unsaturated diacids as well as on the amount of styrene. In some cases the styrene was replaced by another grafting agent. The mechanical properties were determined by tensile tests and Brinell hardness. They bring out the influence of the grafting degree and the styrene content. Author (ESRO)

N68-30887 Utah Univ., Salt Lake City.

SINTERING AND GRAIN GROWTH OF THORIA GELS. PART 1: SINTERING AND GRAIN GROWTH OF THORIA GELS CONTAINING CALCIUM OXIDE. PART 2: EXTENDED STUDY OF GRAIN GROWTH OF THORIA GELS

Suk Joong Im (Ph.D. Thesis) 1967 200 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-12202

The effect of calcium impurity on sintering of thoria gel compacts was studied through measurements of shrinkage and grain growth. The thoria gels with various calcium concentrations were obtained by adding calcium nitrate up to 1% in weight. The average grain sizes of initial thoria gels were in the range of 60 to 85 Å, and the maximum average grain size during sintering at 850°C and 300 Å. Grain boundary diffusion was found to explain the sintering data well except for higher temperatures above 950°C. In addition to the grain size determination, during presoaking and firing, by electron microscopy and X-ray line broadening techniques, the density change was studied on each sample fired in the ambient atmosphere. Thoria gel samples were presoaked at 900°C for several hours in N_2 and H_2 atmospheres and the densities were measured by means of toluene displacement. Dissert. Abstr.

N68-30907 Delaware Univ., Newark.

THE SIGNIFICANT STRUCTURES THEORY OF POLYETHYLENE

Charles Winfield Steward, Sr. (Ph.D. Thesis) 1966 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11736

A liquid theory of polymers, based on the method of significant structures, is derived and applied to calculate the thermodynamic, transport, and surface properties of amorphous polyethylene. The model identifies three significant structures in the liquid state. First, solid-like degrees of freedom result from the binding of a molecule to an equilibrium position by its neighbors. The second significant structure arises from possible positional degeneracy in the solid-like structure. Finally, gas-like degrees of freedom occur as a molecule escapes in at least one direction from the solid lattice. The expansion of a liquid on melting is explained as the introduction of holes of molecular size into the lattice structure. Assuming a random distribution of holes and molecules, $(V-V_s)/V$ is taken to be the fraction of gas-like degrees of freedom and V_s/V the solid-like fraction, where V_s and V are, respectively, the molar volumes of the solid and liquid phase. It is shown that the viscosity depends on the free volume of the liquid but not at all on the degeneracy factor, whereas the surface tension depends critically on the degeneracy term. Dissert. Abstr.

N68-30956# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.

THE EFFECT OF SULFONATES ON THE PERMEABILITY OF OIL FILMS

Peter Martin, Jr. May 1968 15 p refs
(RIA-68-1187; AD-670974)

The intent of the study was to measure the permeability of oil films to water vapor and to relate this property to the oils protective ability. Ther permeation of water vapor through oil films was determined by measuring the surface potential changes as the metal/oil interface with the vibrating condenser apparatus. Surface potential data showed the following order of increasing water adsorption for oil solutions containing 2% by weight of metal dinonylnaphthalene sulfonates (DNNS): CaDNNS, EtDDNNS, BaDNNS, ZnDNNS, NH4DNNS, PbDNNS and NaDNNS. The study showed that surface potentials could be used to distinguish the difference between the metal dinonylnaphthalene sulfonates. Also, the surface potential changes caused by water vapor adsorption [illegible] shown to correlate with the protective ability in the humidity cabinet test. Author (TAB)

N68-30966 Illinois Univ., Urbana.

ULTRASONIC ABSORPTION IN AQUEOUS SUSPENSIONS OF SMALL ELASTIC PARTICLES

Stephen Arthur Hawley (Ph.D. Thesis) 1967 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-11861

The absorption of ultrasound has been measured in aqueous solutions of dextran, a quasi-linear anhydroglucose polymer, and in aqueous suspensions of small polystyrene particles. The absorption in dextran solutions has been found to be independent of molecular weight, and substantially greater than would be anticipated from the dynamic shear viscosity contributions predicted on the basis of the Rouse theory. The absorption in aqueous polystyrene lattices has been measured in five suspensions. Comparison of the absorption behavior of the Lamb–Urick–Epstein theory and to results obtained in bulk polystyrene reveal that neither relative motion nor internal viscosity of the particle contribute substantially to the observed

acoustic attenuation. An Arrhenius dependence of absorption coefficient on temperature is observed in the lattices. Dissert. Abstr.

N68-31041# Federal Aviation Administration, Atlantic City, N. J.
FLAMING AND SELF-EXTINGUISHING CHARACTERISTICS OF AIRCRAFT CABIN INTERIOR MATERIALS Final Report
John F. Marcy and Richard Johnson Jul. 1968 95 p refs
(NA-68-30; DS-68-13)

A study was made of the burning characteristics of some 140 different materials for the purpose of obtaining technical data and criteria needed to support current efforts to improve existing Federal Air Regulations governing the use of cabin interior materials. Comparative tests were conducted on materials now in use in air transport, and materials proposed for future use with superior fire resistance. Measurements were made of ignition time, burn and char lengths, flame-out time, burn rate, heat of combustion, flame-spread index, etc. Two standard laboratory test methods were employed; namely, (1) Federal Standard CCC-T-191b, Test Method 5902, Vertical Burning Apparatus, and (2) Federal Standard 00136b (ASTM E-162), Radiant Panel Apparatus. Results were analyzed to indicate major flammability trends for different material classifications. Practical allowable flammability limits based on available materials technology were recommended for increasing the present fire protection requirements of interior materials. Author

N68-31060# Army Weapons Command, Rock Island, Ill. Research and Engineering Div.
PULSE POLARIZER STUDIES OF CORROSION PREVENTIVE OILS
Peter Martin, Jr. May 1968 18 p refs
(RIA-68-1210; AD-670973)

The purpose of the study was to find a method which would require less time and be more accurate than corrosion tests currently used in military specifications. Various electrical methods are discussed as to their ability to evaluated effectively corrosion preventive oils. The Pulse Polarizer method was applied to iron specimens coated with corrosion preventive oils and immersed in a 1N KCl solution. The efficiency of the oil was based on its ability to restore a breakdown of the film, caused by pulse discharge, to its original noncorrosive equilibrium potential. A good correlation was obtained when the potential data of MIL-L-3150 and MIL-L-21260, Grade 1 oils were compared to their protective ability in the JAN-H-792 Humidity Cabinet Test. The results indicate that the Pulse Polarizer technique can be used to determine the protective ability of the two types of corrosion preventive oils studied. Author (TAB)

N68-31099# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
ATOMIC DIFFUSION IN CERAMIC OXIDES
H. J. de Bruin, D. H. Bradhurst, and D. G. Walker Dec. 1967 39 p Presented at the Symp. on Properties of Mater. at High Temp., Sydney, 21–22 Aug. 1967
(AAEC/E-188; CONF-670837-1)

Diffusion mechanisms in ceramic oxides are considered and available data in the literature broadly reviewed. It is noted that a simple correlation for cation self-diffusion in oxides based on structural considerations is not likely to eventuate, although some correlation for oxygen diffusion should exist. Greater sensitivity is required to study diffusion in oxides that can be obtained by conventional tracer lapping. The less common methods that may be applicable are reviewed. Author (NSA)

N68-31115# New York Univ., N. Y. Research Div.
NUCLEATION PHENOMENA IN POLYMERS Final Report, 15 Jul. 1964–14 Dec. 1966
Walter Brenner, R. F. Shaffer, R. Vermes, Charles Marsel, and William H. Kapfer May 1968 216 p refs
(Contract N60921-7119)
(AD-671093)

The effects of nucleating agents on the physical strength properties of selected thermosetting polymer systems were experimentally investigated with emphasis on modified polyamides and specially synthesized ordered epoxy polymers. Nucleating agents such as sodium phenyl phosphinate added in the order of 1 wt. % based on the polymer weight, substantially enhance tensile strength etc. of both Nylon 6 and Nylon 66 polyamides. Morphologically the spherulites formed on cooling from the nucleated polymer melts were very much smaller with overall crystallinities essentially unchanged. With suitable experimental conditions chemical and irradiation crosslinking of such nucleated polymers does not materially lower the level of the strength properties attained by nucleation. The use of glass fiber reinforcements such as, for example, 181 type cloth, not unexpectedly tends to mask the increased strength properties of nucleated crosslinked polyamides. A number of ordered cross linkable epoxy type polymers and copolymers were synthesized using catalyst systems such as ferric chloride propylene oxide complexes and zinc alkyls. Butadiene monoxide containing copolymers have proven of particular interest because of their residual vinyl unsaturation which permits subsequent cross linking via peroxides, irradiation etc. Remarkably high strength properties were obtained with such nucleated and mechanically oriented crosslinked copolymer films etc. These compositions should be further investigated as high strength binders for structural plastic compounds. Author (TAB)

N68-31293# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
CRYSTALLIZATION AND MELTING OF POLYETHYLENE UNDER PRESSURE
Theodore Davidson 1 Jun. 1968 148 p refs
(Contract Nonr-591(19))
(TR-13; AD-670988)

The crystallization conditions which lead to extended-chain polyethylene under elevated pressure were elucidated further. The dependence of polyethylene density on crystallization pressure on slow cooling was extended up to 6980 bars. No further improvement of crystal perfection or extension of polymer chains were observed. At 5000 bars the temperature of crystallization was varied between 170 to 270C. Temperatures between 195 and 225C were found suitable for crystallization of extended chain polyethylene. A time sequence at 200C and 5000 bar revealed some insight in the formation of extended chain polyethylene. It is thought to involve a two step process of nucleation of folded chain lamellae, followed by solid state chain extension. High pressure differential thermal analysis apparatus has been developed for measurement up to 3700 bar. Folded as well as extended chain crystals of polyethylene were analyzed. Only the extended chain crystals show an initial increase in melting point in accord with the Clausius Clapeyron equation. Author (TAB)

N68-31318# Naval Research Lab., Washington, D. C.
EFFECT OF ADSORBED WATER ON WETTING PROPERTIES OF BOROSILICATE GLASS, QUARTZ, AND SAPPHIRE
Marianne K. Bennett and W. A. Zisman May 1968 20 p refs
(NRL-6705; AD-671180)

Contact angles of a variety of hydrophobic liquids were measured on clean surfaces of borosilicate glass, quartz, and sapphire at 20C with the RH at 0.6% and 95%. The adsorption of water molecules at 0.6% RH resulted in the formation of only a fraction of a monolayer; yet, this fraction converted each high-energy solid surface to one having a low critical surface tension of wetting, gamma sub c. The increased amount of water adsorbed at 95% RH to form a film comprising little more than a condensed

monolayer further lowered gamma sub c to a value somewhat above that of bulk water. At each RH investigated the value of gamma sub c was the same for each of these three solids; hence, gamma sub c was dependent upon the surface concentration of adsorbed water but was independent of the chemical nature of the solid substrate. The somewhat different values of gamma sub c obtained on using several different homologous series of hydrophobic liquids are explained in terms of differences in the contribution from nondispersion interfacial forces acting between the water film and the contacting organic-liquid molecules. These results reveal clearly the important influence of only a monolayer of adsorbed water upon the spreading, adhesion, and contact angles of organic liquids resting upon high-energy, hydrophilic, solid surfaces. To illustrate the effect of the baking pretreatment temperature on the removal of physically adsorbed water, the three specimens were dried at three temperatures: 65C, 120C, and 215C. No significant differences were found on the specimens following baking treatment at the different temperatures. Author (TAB)

N68-31341 Rensselaer Polytechnic Inst., Troy, N. Y.
THE SOLID STATE OF NYLON 6
Frank Nunzio Liberti (Ph.D. Thesis) 1967 198 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-12839

A zone melting apparatus was used to produce high molecular weight samples of nylon 6 consisting of extended molecular chains. The new morphology of nylon 6 was shown to be in the α-paracrystalline monoclinic crystal form and is composed of parallel molecular chains. A melting study of all crystal morphologies of nylon 6 was undertaken. In contrast to extended-chain nylon 6 which was shown to superheat, melt crystallized polymer of $\overline{M}_w$ = 82,000 showed reorganization throughout the range of heating rates applied. Crystallization of melt-crystallized nylon 6 from glycerine solutions of 0.005% by weight resulted in both lamellar and spherulitic morphology. A network-like structure was also noted, but its fine structure could not be determined. Lamellar single crystals could only be prepared by quenching glycerine solutions or allowing them to cool under a room temperature gradient. Crystallizations at various constant temperatures from 140 to 155°C resulted in spherulitic morphology. The thickness of all lamellae was 50–60 A. Dissert. Abstr.

N68-31374# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materiels Lab.
A STATISTICAL ANALYSIS OF BUNDLE TESTS Technical Report, May–Jul. 1966
Stephen W. Tsai and Stanley Schulman Apr. 1968 22 p refs
(AFML-TR-67-351; AD-671119)

Experimental results of bundle tests of single-end glass, with and without epoxy resin, are compared with the predictions of statistical theories based on the normal and Weibull distributions. The effect of gage lengths varying from 1 to 20 inches is also investigated. Based on the results, bundle tests may be considered for the determination of the strength and the coefficient of variations of monofilaments, as well as the axial strength of unidirectional composites. Author (TAB)

N68-31385# Naval Ammunition Depot, Crane, Ind.
EVALUATION OF ANTISTATIC COATINGS FOR POLYSTYRENE CONTAINERS
Clifford W. Muessig Apr. 1968 26 p refs
(NAD-CR-RDTR-111; AD-671187)

The technique for preventing static charge buildup on the surfaces of polystyrene containers has not been completely satisfactory. Problems in formulation and stability of the antistatic solution have continually been mentioned by the manufacturers of the polystyrene containers. In the work described in this report a new improved formulation as an antistatic coating for polystyrene containers was shown to be much more satisfactory than the one presently being used. It has, therefore, been recommended in the revised drawing for all new contracts for the manufacture of polystyrene containers. Author (TAB)

N68-31537# Compagnie Générale d'Electricité, Paris (France).
FABRICATION OF LITHIUM AND MAGNESIUM FLUORIDE SINGLE CRYSTALS [FABRICATION DE MONOCRISTAUX DE FLUORURE DE LITHIUM ET DE FLUORURE DE MAGNESIUM]
G. Petitjean *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 88–97 (See N68-31528 19-23)

The fabrication of single crystals involves choice of raw materials, growing of crystals, cutting and quality control. These different points are analyzed in the case of lithium and magnesium fluoride single crystals with good transparency in the far ultraviolet. ESRO

N68-31598# Oak Ridge National Lab., Tenn. Office of Language Services.
SPIRAL GROWTH IN PYROLYTIC CARBON
E. Fitzer and H. Schlesinger [1968] 16 p refs Transl. into ENGLISH from Carbon (London), v. 3, 1965 p 247–255
(ORNL-TR-1890) CFSTI: HC $3.00/MF $0.65

Spiral growth was observed in deposits of pyrolytic carbon produced by thermal decomposition of methane in the temperature range from 1400° to 1700°C. The growth spirals are multiple spirals with diameters of about 5 to 40 μ and a height of a single step of about 1000 Å. Spiral growth was observed by optical and electron microscopic techniques. The spiral structure was also observed in the cross sections of the deposits; the cones of the pyrolytic carbon were formed by a multiple spiral. An explanation is given of the growth mechanism of the multiple spirals by considering a group of emergence points lying on one line and all with the same growth direction. The different densities of the spirally and the normally grown pyrolytic carbon deposits is discussed from the kinetic point of view. Author (NSA)

N68-31648# Du Pont de Nemours (E. I.) and Co., Buffalo, N. Y. Film Dept.
THE ORIENTATION OF POLYETHYLENE CRYSTALLIZED FROM THE ORIENTED MELT
G. C. Adams and G. J. Ostapchenko [1967] 21 p refs
(Publ.-247)

The recent qualitative results of Keller and Machin have received quantitative verification. We have obtained Hermans' X-ray orientation parameter and detailed birefringence measurements on linear polyethylene (of broad and narrow molecular weight distribution) and on branched polyethylene (with short and long chain branches). The polymers were crystallized from the melt after stretching. The results suggest that the high molecular weight species in linear polyethylene cause molecular entanglements during orientation on the melt. Such entanglements lead to intrinsic nuclei formation which results in the row structure proposed by Keller. The detailed birefringence and crystal orientation studies enable a determination of amorphous orientation. For the row structure the amorphous chains are found to lie principally in the film plane rather than in a plane perpendicular to the stretch direction as had been suggested. Author

N68-31794# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
A MASS-THERMAL METHOD FOR STUDYING ABLATIVE POLYMER DEGRADATION MECHANISMS

Camille A. Gaulin, Francis M. Wachi, and Donald E. Gilmartin Mar. 1968 17 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-40)-7; SAMSO-TR-68-192; AD-670535)

An analytical method is described that provides detailed identification of the chemical species evolved during thermal decomposition of ablative polymers. The method combines the two techniques of differential thermal analysis and mass spectral analysis to record simultaneously the thermal behavior of the polymers and the mass spectra of their decomposition products. The method and its application to polymer systems is demonstrated by its application to polystyrene decomposition. The results obtained with ablative polymers are directly useable in an ablation or observable analysis. Author (TAB)

N68-31841# National Research Council of Canada, Ottawa (Ontario).
A METHOD OF PREPARATION OF PETN-IMPREGNATED FOAMS CAPABLE OF INITIATION BY GASEOUS DETONATION WAVES
A. H. Makomaski and J. A. Darling Feb. 1968 15 p refs
(NRC-10168; MT-60) CFSTI: HC $3.00/MF $0.65

A technique is described for impregnating polyurethane foam with PETN. The method consists of soaking up the foam in a saturated PETN/acetone solution and precipitating the crystals within the foam by rapid dilution with water. Using foams ≈1 inch in diameter, precipitation from a solution at the boiling point (≈61 1/2°C) results in the explosive loading density of ≈0.45 gm/cc. Satisfactory agreement of the average loading densities with prediction, based on the solubility data for PETN in acetone, is obtained for the temperature range of 20°C to 58°C for foams of ≈1 inch and ≈5 1/2 inches in diameter. Author

N68-31898*# TRW Systems, Redondo Beach, Calif.
THE DEVELOPMENT AND CHARACTERIZATION OF NEW STORABLE PROPELLANT BLADDER MATERIALS Final Report, 15 Mar.–25 Nov. 1966 and 13 Mar. 1967–15 Jan. 1968
H. R. Lubowitz, J. F. Jones, R. A. Meyers, and E. A. Burns 15 Feb. 1968 106 p refs
(Contract NAS7-446)
(NASA-CR-96156; TRW-6104-6013-R000) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A systematic synthesis and testing program was conducted to determine the trade-offs among chemical resistance, permeability, and mechanical properties that could be realized by introducing points of flexibility into the poly(cyclized 1,2 polybutadiene)tolyl urethane (CPBU) polymer structure. Eight approaches were explored: internal plasticization, backbone structure variation through copolymerization, butyl rubber vulcanization with poly 1,2-butadiene, introducing flexibility points in the chain extender, modifying the fused cyclohexane ring structure by chain transfer, preparing CPBU-rubber composites, external plasticization, and non-chain extended CPBU. These synthesis procedures are described, and the candidate materials are characterized. Based on these data, studies were undertaken to prepare CPBU/elastomer composite vulcanizates with elastomers considered to be compatible with nitrogen tetroxide. The findings show that it was not possible to determine whether elastomeric compositions containing CPBU uniquely prevent N_2O_4 permeation in comparison with other inert fillers. M.G.J.

N68-32037*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
HIGH THERMAL CONDUCTIVITY POLYMERIC MATERIALS FOR SPACECRAFT USE Interim Summary Report, 1 Jul. 1966–1 Jun. 1968
R. K. Jenkins 1 Jun. 1968 70 p refs
(Contract NAS5-10260)
(NASA-CR-96121; SM-49143-S-1) CFSTI: HC $3.00/MF $0.65 CSCL 11J

This program was undertaken to investigate the possibility of preparing new classes of polymers, which through various structural geometries, and modifications would give rise to increased thermal conductivity. The design goals recommended for the program were: Electrical Resistivity, 1×10^{10} ohm cm; Thermal Conductivity, 0.05 cal/cm-sec-°K; Working Temperature, −30° to 200°C; Working Pressure, Ambient to 10^{-12} torr. The program plan for the study of thermally conductive polymers involved an initial literature survey followed by analysis of available data. The results of the survey led to a program to determine the contribution of various parameters, such as (1) electron density, (2) crosslink density, and (3) crystallinity, to the thermal conductivity of a particular polymer structure. It was found that the best system for obtaining enhanced thermal conductivity was that of the diamine/quinone (quinhydrone) polymers. The thermal conductivity was in the middle-to-low 10^{-3} cal/cm-sec-°C range, the electrical resistivity was 10^{12} to 10^{15} ohm-cm and they exhibited thermal stability to 200°C. Author

N68-32085# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
GRAPHITE FIBER/EPOSY RESIN MATRIX COMPOSITES Technical Report, Jun. 1966–Sep. 1967
R. J. Deuksys, N. N. Pagano, and R. G. Spain Apr. 1968 32 p refs
(AFML-TR-67-367; AD-670597)

Four types of graphite fibers were utilized as reinforcements in a continuing experimental program of the fabrication and evaluation of epoxy resin matrix composites. Resultant composite data and analyses continue to demonstrate a high promise for graphite fiber reinforced resin composites as high performance materials. Author (TAB)

N68-32186# Du Pont de Nemours (E. I.) and Co., Buffalo, N. Y.
CONTROLLING THE SENSITIVITY OF CELLOPHANE TO MOISTURE
V. C. Haskell [1967] 34 p refs Presented at the 2d Intern. Symp. on Viscose Tech. Questions, Stockholm, 2–4 Oct. 1967
(Publ.-250CE) CFSTI: HC $3.00/MF $0.65

A new method for measuring the dimensional changes of cellophane exposed to a humidity cycle is presented. It is shown that curves of dimensional change versus moisture gain and loss are sensitive to the chemical and mechanical treatments applied to the film. The dimensional stability of cellophane can be improved by crosslinking, treatment with aqueous acids, or by reaction of the cellulose with ethylene oxide or acrylonitrile, but in each case there is some loss of strength and toughness. These observations are compatible with a gel structure consisting of a network of microfibrils which forms new hydrogen bonded junctions during drying, thus locking in the strains. Subsequent humidification relieves the strains in the reverse order that they were imposed on the film. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-31045 Pennsylvania Univ., Philadelphia.
THE OPTIMAL INVERSE AND PROBLEMS OF OPTIMIZATION

George Gumas (Ph.D. Thesis) 1967 184 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-12747

This dissertation investigates the optimal inverse of a bounded linear operator acting on a Hilbert Space. The optimal inverse, as defined, is found to take one of the following forms: (a) the inverse; (b) a left inverse; (c) a right inverse; (d) a pseudoinverse. A rigorous examination of these inverses results in algebraic expressions for the determination of the optimal inverse. It is found that the optimal inverse minimizes two general functionals, one on the image space of the operator and the other on the space of all linear bounded operators defined on the pre-image space. The algebraic results concerning the optimal inverse are extended so as to yield a general solution of the optimal inverse by spectral representation. Considerations to the optimal inverse of a bounded linear operator acting on a Banach space are made. The applicability of the optimal inverse is illustrated by the consideration of the optimal control as well as the identification of linear dynamical systems. This effort yields the classical results of Kalman, further contributing to this by providing a solution for the singular case, as well as presenting well defined algebraic techniques for their solution. Dissert. Abstr.

N68-31050 Rochester Univ., N. Y.
AN INTEGRAL OVER COMPLEX HILBERT SPACE
Norman Fredrick Rehner (Ph.D. Thesis) 1967 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13642

A non-trivial countably additive measure, E-measure, on the unit ball B of complex separable Hilbert space $l_2(C)$ is constructed and studied. In general such a measure m on B might be expected to have the following properties: (1) m-measure is concentrated on the strong boundary of B. (2) Open sets in B have positive m-measure. (3) Integration with respect to m-measure defines a positive continuous linear functional on the space of continuous functions on B. (4) m-measure is invariant under the family of unitary transformations of $l_2(C)$. It is shown that when B is considered in the norm topology or in the weak topology no non-trivial measure on B can satisfy all of (1)-(4). E-measure is constructed by adapting to complex separable Hilbert space $l_2(C)$ a procedure used by Banach in real Hilbert space $l_2(R)$ and by Eberlein in $l_1(R)$. The construction depends on a fixed ordered orthonormal basis $\{e_0, e_1, \ldots\}$ for $l_2(C)$. E-measure is shown to have properties (1), (2) and (3) listed above when B is considered with the weak topology. A short table of integrals is given. Dissert. Abstr.

N68-31073# Illinois Univ., Urbana. Dept. of Computer Science.
ENUMERATION OF THRESHOLD FUNCTIONS OF EIGHT VARIABLES
S. Muroga, T. Tsuboi, and C. R. Baugh 2 Aug. 1967 63 p refs
(Rept.-245; PB-177451) CFSTI: HC $3.00/MF $0.65

The report considers the problem of how many Boolean functions of n variables are actually threshold functions. Threshold functions have been enumerated by a few authors for n equal to 7 or fewer. In this paper all threshold functions of eight variables are enumerated and algebraic properties of these functions and sets of optimum structures which realize them are investigated. The digital computer of the University of Illinois, ILLIAC II was used for this study. USGRDR

N68-31075# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A NOTE ON TESTS FOR MONOTONE FAILURE RATE BASED ON INCOMPLETE DATA
R. E. Barlow and F. Proschan Apr. 1968 15 p refs *Its* Mathematical Note No. 555
(Contract Nonr-3656(18))
(D1-82-0716; AD-671020)

Certain tests of constant failure rate versus failure rate increasing on the average are unbiased when complete samples of observations are available, as pointed out by Bickel and Doksum in the Annals of Mathematical Statistics (1968). In the present note, unbiasedness is proved when incomplete samples of failure data are available. A similar result is obtained for monotone tests of constant versus increasing failure rate. Finally, a table of percentiles is given to facilitate application of the total time on test statistic for testing constant failure rate versus failure rate increasing on the average. Author (TAB)

N68-31077# California Univ., Los Angeles. Dept. of Mathematics.
ROYDEN'S COMPACTIFICATION OF RIEMANNIAN SPACES Interim Technical Report
John S. M. Chang (Ph.D. Thesis) Apr. 1968 78 p refs
(Grant DA-ARO(D)-31-124-G855)
(TR-45; AROD-6929.17-M; AD-670970)

Roydens compactification R^* of a noncompact Riemannian space R is constructed and properties of HBD- and HD-functions on R are investigated. The tools employed are weak* topology and Riesz representation theorem, all introduced in earlier work of H. Royden and M. Nakai. The results constitute an extension to general Riemannian spaces, of arbitrary dimension $n > 2$, of properties known for such classes of functions on a Riemann surface. Author (TAB)

N68-31104# Washington Univ., Seattle. Dept. of Psychology.
ASSOCIATION MEASURES OF BINARY VARIABLES: AN EMPIRICAL COMPARISON WITH RESPECT TO FACTOR STRUCTURES REPRODUCTION
Leslie Allan Fox Jun. 1968 225 p refs
(Contract Nonr-477(33))
(AD-671074)

The research begins with known factor structures on the basis of which data matrices are generated. These are converted to a number of binary matrices differing with respect to vectors of means. For each of these, several different types of matrices of association indices are calculated and a varimax-type factor analysis is applied. The criterion of effectiveness of an index of association is taken to be the adequacy with which it recovers the known factor structures. According to this criterion, the research indicates that: (1) The matrix of association indices should be Grammian, since phi tends to be superior to other indices of association. (2) Sample size and distribution of underlying factor scores appear to have negligible influence on the relative effectiveness of any of the indices of association. (3) The phi coefficient is relatively less sensitive than other indices to disparity of means. (4) The tetrachoric coefficient, although in no case the poorest index of association, is seldom the best. Author (TAB)

N68-31178 Polytechnic Inst. of Brooklyn, N. Y.
AN APPLICATION OF DIAKOPTICS IN THE DETERMINATION OF TURBINE BUCKET FREQUENCIES BY THE USE OF PERTURBATIONS
Ozcan Tuncel (Ph.D. Thesis) 1967 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-13426

The method of uncoupling or Diakoptics is applied to determine the natural frequencies of coupled buckets by using perturbation methods. A complete set of algorithms is derived for the perturbation coefficients for a general representation of the eigenvalue problem. The algorithm of perturbation coefficients is then modified for the application to bucket frequency calculations. Since the very

nucleus of Diakoptics is the formulation and tearing of the coupling matrix, equations are derived for the coupling effect of the tie-wires and the cover. Various approximations of the coupling equations are considered to include the effect of the natural frequencies of the coupling segments on the coupled bucket frequency. Starting with the natural frequency and the corresponding mode shape of a single bucket in the group, the coupled frequency is obtained by perturbations according to the coupling influence. It is found that the proper representation of the grouped buckets by a single bucket is of utmost importance for obtaining accurate coupled frequencies. Influence of additional perturbation terms on the resultant coupled frequency is investigated and it is found that the first term is the dominating term for numerical computations. Dissert. Abstr.

N68-31185# RAND Corp., Santa Monica, Calif.
TRANSVERSALS OF INFINITE FAMILIES WITH FINITELY MANY INFINITE MEMBERS
Jon Folkman Jun. 1968 38 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5676-PR; AD-671114)

The main theorem of this study gives necessary and sufficient conditions for an infinite family of sets with only finitely many infinite members to have a transversal. It is also shown that the existence of a transversal of an infinite family of sets with only countably many infinite members is equivalent to the existence of a function from the subsets of the index set of one family to the cardinal numbers having certain properties. The most important known results in the area are presented, as well as two examples illustrating the difficulties encountered in attempting to generalize the result. Author (TAB)

N68-31194# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND FREDHOLM INTEGRAL EQUATIONS WITH DISPLACEMENT KERNELS ON AN INFINITE INTERVAL
H. H. Kagiwada, R. E. Kalaba, and B. J. Vereeke May 1968 15 p refs
(Contract F44620-67-C-0015; Proj. RAND)
(RM-5646-PR; AD-670570)

A new initial-value method is given for solving Fredholm integral equations on an infinite interval. Instead of solving the initial-value problem previously derived for the finite interval case and allowing the interval to tend to infinity, the method makes use of a generalized Ambarzumian integral equation in connection with an initial-value problem to solve the Fredholm equation. A numerical example from radiative transfer indicates that the results obtained by use of the method agree well with previously published results. Author (TAB)

N68-31250 Yeshiva Univ., New York.
ON TOPOLOGICALLY NON-TRIVIAL FIELDS
Julio Rubinstein (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-14587

We study here a class of field theories in which the range (not the domain) of the field is topologically non-trivial, i.e., does not admit a vector space structure. A simple model in one space dimension is analyzed first, and solutions to the non-linear equations of motion are given. The system is quantized in a low-speed approximation and by conventional methods. The model has some unusual properties, and their possible relation with a full physical theory is discussed. The rest of the work is devoted to a general formulation of three-dimensional theories. In particular, we introduce the concepts of field spin and field exchange, and a relation between them is proven; this is done without employing Lorentz invariance or analyticity. Also, parastatistics are shown to be forbidden within the present framework. Dissert. Abstr.

N68-31259 California Univ., Los Angeles.
SPHERICITY AND ELLIPSOIDALITY THEOREMS FOR BODIES STAR-SHAPED RELATIVE TO AN OPEN SET
Carl Haimson Dorn (Ph.D. Thesis) 1967 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14300

Aryeh Dvoretsky has shown that every centrally symmetric convex body in a space of sufficiently high dimension has k-dimensional sections which are nearly spherical. He further showed that under certain restrictions the majority (in the sense of Haar measure) of all central sections of a centrally symmetric convex body is nearly spherical. Straus, then, showed that given any l-tuple of centrally symmetric convex bodies with their center of symmetry at the origin (in a space of sufficiently high dimension), there is a k-dimensional subspace which intersects each body in a set which is almost spherical. In this paper, the relationship between the variables in Dvoretsky's measure theoretic theorem is explored. Then, an affine invariant measure is defined and Dvoretsky's theorem on containing space is sufficiently high). These results are then extended to non-symmetric convex bodies and finally to bodies star-shaped relative to an open set. Dissert. Abstr.

N68-31516* Radio Corp. of America, Princeton, N. J.
FORTRAN SUBPROGRAMS FOR COMPLETE ELLIPTIC INTEGRALS
F. I. Zonis [1968] 19 p refs
(Contract NAS2-3772)
(NASA-CR-73245) CFSTI: $3.00 CSCL 12A

Fortran II subprograms have been developed for evaluating the complete elliptic integrals of the first and second kinds on the RCA 601 computer. These subprograms exhibit an error no greater than $2\,(10)^{-8}$ over the entire range of definition. Author

N68-31707
INVESTIGATION OF THE ZEROES OF THE TRANSCENDENTAL FUNCTION
T. I. Chukanova [1968] 3 p refs Transl. into ENGLISH from Vychisl. Matem. i Matem. Fiz. (USSR), v. 8, no. 2, 1968 p 415–417
CFSTI: HC $3.00/MF $0.65

The use of the Laplace transform in solving boundary value problems is examined in relation to the necessity of investigating the roots of the transcendental equation $g(z)I_\nu(z)+h(z)I_{\nu+1}(z)=0$, where $I_\nu(z)$ is a Bessel function of the first kind of imaginary argument. Theorems are formulated to prove that the function has no zeroes in the right half-plane for any functions h(z) and g(z) for which $\mathrm{Re}(h(z)/g(z))\geq 0$ for any real v; it is assumed that h(z) and g(z) do not have common zeroes. Author

N68-31721
ON THE CONVERGENCE AND STABILITY OF THE METHOD OF LEAST SQUARES
A. Iu. Luchka [1968] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk. Ukr. Rsr. Ser. Fiz. Mat. Nauk (USSR), no. 2, 1968 p 115–118
CFSTI: HC $3.00/MF $0.65

Theorems are given to prove the convergence and stability of the least squares method. Equations are derived to show that the convergence in the complex separable Hilbert space H does not directly demand completeness of the system in H_A because it results from the assumptions imposed on the linear operator A and the system. Consideration is also given to the case when A is a symmetric operator. It is shown that the theorems are valid even if the linear operator A transforms a compact set in H into the complex separable Hilbert space H_2. Proof is also offered to show that if the system is a strong minimum in H, it will be a strong minimum in H_2 and that the approximation constructed by least squares is stable. M.G.J.

N68-31752# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
A GRADIENT PROJECTION METHOD FOR CONSTRAINED OPTIMIZATION
Kenneth E. Cross 30 May 1968 25 p refs
(Contract W-7405-ENG-26)
(K-1746) CFSTI: HC $3.00/MF $0.65

A description is made of the constraint portion of a nonlinear optimization program which was developed for the purpose of solving a series of engineering design and economic problems. Additional capabilities were incorporated into an existing gradient search program to enable the consideration of both linear and nonlinear, equality and inequality, constraints. A rather nontheoretical approach is attempted in describing both the philosophy and the mechanics involved in the constraint techniques. Author (NSA)

N68-31755# Maryland Univ., College Park. Computer Science Center.
ON SOME METHODS OF SOLVING NONLINEAR EQUATIONS
M. N. Yakovlev Jul. 1968 76 p refs Transl. into ENGLISH from Tr. Mat. Inst., Akad. Nauk SSR (Moscow), v. 84, 1965 p 8–40
(Grant NsG-398)
(TR-68-75)

Consideration is given to iterative methods of the type $x_{n+1} = x_n - d_n A_n F(x_n)$ for the solution of the nonlinear equation $F(x) = 0$ in a Hilbert space where F is the gradient of a nonlinear functional f(x). Several results are obtained concerning existence of solutions and conditions for convergence. The developed iterative methods are then applied to nonlinear systems arising from the Ritz method. Another method, called differentiation with respect to a parameter, is treated which essentially involves the solution of the operator equation $f(x) = 0$ in R^n which is imbedded in the family of equations $F(x,\lambda) = 0, \lambda \in [0,1]$. Under suitable assumptions, a solution $x(\lambda)$ exists which satisfies a certain Cauchy problem. Existence of the Cauchy problem solution and the uniqueness of domain are demonstrated and establish the method. Application of this method is discussed for systems arising from Galerkin's method for nonlinear positive definite operators. D.H.B.

N68-31758
GENERALIZED METHOD OF SOLVING LINEAR INTEGRAL EQUATIONS OF THE SECOND KIND
V. Iu. Sereda [1968] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. Rsr., Ser. A, Fiz. Tekhn. i Mat. Nauk (USSR), no. 2, 1968 p 127–131
CFSTI: HC $3.00/MF $0.65

A generalized approximation method is constructed, which includes the positive advantages of successive approximations, replacement by a degenerate kernel, averaging of functional corrections, and strips. An error estimate of the method is established which affords a possibility of selecting the parameters needed to construct an approximate solution of the desired accuracy with a minimum of labor expenditure. Author

N68-31827# California Univ., Los Angeles. Western Management Science Inst.
AN IMPROVED IMPLICIT ENUMERATION APPROACH FOR INTEGER PROGRAMMING
A. M. Geoffrion May 1968 33 p refs ITS Working Paper 137
(Contract Nonr-233(75))
(AD-670735)

The memorandum synthesizes the Balasian implicit enumeration approach to integer linear programming with the approach typified by Land and Doig and by Roy, Bertier and Nghiem. The synthesis results from the use of an imbedded linear program to compute surrogate constraints that are as strong as possible in a sense slightly different from that originally used by Glover. A very simple implicit enumeration algorithm fitted with optional imbedded linear programming machinery was implemented and tested extensively on an IBM 7044. Use of the imbedded linear program dramatically reduced solution times in virtually every case, and sufficed to render the tested algorithm superior to the five other implicit enumeration algorithms for which comparable published experience was available. It would appear that the present approach permits the routine solution of practical integer programs involving hundreds of variables. Author (TAB)

N68-31877# Northwestern Univ., Evanston, Ill. Technological Inst.
ON THE COMPUTATION OF CANONICAL CORRELATIONS
Claude Cohen (Illinois Univ.) and Adi Ben-Israel Mar. 1968 13 p refs *Its* Systems Res. Memo.-199
(Grant NSF GP-7550)
(PB-177891)

The problem of canonical correlations is formulated and solved as an eigenproblem without the usual non-singularity assumptions. The proposed algorithm has the additional advantage that the matrices in the eigenproblems are symmetric. USGRDR

N68-31961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EFFICIENT METHOD FOR COMPUTATION OF CHARACTER TABLES OF FINITE GROUPS
Gabriel Allen Washington Aug. 1968 29 p refs
(NASA-TN-D-4763) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A systematic procedure is presented for constructing the character table of a given finite group. The use of this procedure makes the task of computing group character tables more straightforward than previously published procedures. Each step in the construction of the character tables is illustrated by worked out examples. Group tables, character tables, and class algebra tables for many of the common finite groups are included. Author

N68-31983*# Institute of Modern Languages, Inc., Washington, D. C.
SOME PROPERTIES OF SPECIFIC INTEGRALS OF THE CAUCHY TYPE AND THEIR APPLICATIONS [NEKOTORYYE SVOYSTVA OSOBYKH INTEGRALOV TIPA KOSHI I IKH PRILOZHENIYA]
V. V. Ivanov NASA Jul. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 121, no. 5, 1958 p 793–794
(Contract NASw-1693)
(NASA-TT-F-11553) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Limited cases of the Plemel–Privalow theorem are studied. The results are applied to the solution concening structural properties of the Riemann boundary value problem and the singular integral equation of normal type. Author

N68-31999*# Brown Univ., Providence, R. I.
BEHAVIOR NEAR A PERIODIC ORBIT OF FUNCTIONAL DIFFERENTIAL EQUATIONS
Jack K. Hale [1967] 9 p refs
(Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270; Grants AF-AFOSR-693-67; NSF GP-7471)
(NASA-CR-95959) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The qualitative theory of autonomous functional differential equations is discussed, and some of the results obtained for equilibrium points and periodic orbits are presented. Consideration is also given to the concept of functional differential equations on a compact manifold, to the incomplete theory of nondegenerate and elementary periodic orbits, and to the stability properties of a periodic orbit. M.G.J.

N68-32157# Stanford Univ., Calif. Graduate School of Business.
THE CONTROL OF A MULTIPLE FACILITY, MULTIPLE CHANNEL QUEUEING SYSTEM WITH PARALLEL INPUT STREAMS
Alan John Rolfe Mar. 1968 202 p refs
(Grant NSF GS-552)
(TR-22; PB-178070) CFSTI: HC $3.00/MF $0.65

This dissertation treats the problem of controlling the input to a multiple facility multiple server queueing system. The controller desires to optimize an economic cost function. The general model is described in detail, the cost function is derived, and notation is established. Two special cases of the general model for which results are possible are presented. For several subcases of these two models operating characteristics and optimization results are given. USGRDR

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-31076# Massachusetts Inst. of Tech., Cambridge. Meteorology Dept.
A FIELD INVESTIGATION OF AIR FLOW IMMEDIATELY ABOVE OCEAN SURFACE WAVES
John R. Seesholtz May 1968 151 p
(Contract Nonr-1841(74); Grant NSF GP-4321)
(AD-670539)

Simultaneous measurements of wind velocity and water height were made on eleven days at an exposed site off the New England coast. While a wave gauge measured water height, a vertical array of anemometers recorded wind velocities at as many as eight heights up to 12 meters above mean sea level (MSL). The three lowest anemometers were arranged to float 30, 50 and 70 cm above the instantaneous water surface. Continuous atmospheric pressure and temperature measurements were made during several runs. An analysis of this data indicates that to a good first approximation, the horizontal wind velocity increases as a logarithmic function of height. Limited data from cross-correlations of pressure and wave indicate that at a height of 1 to 2 meters above MSL, the maximum pressure occurs near the trough. The measured energy transfer rate to the waves in a developing sea and the rate predicted by Miles theory are in reasonable agreement. The averaging of data over long periods or making strong assumptions about the wind profile and its slope seriously degrade calculations based on Miles theory. Short-term changes in wind velocity and the profile and shear stresses near or at the surface may be very important in the wave generation process. Author (TAB)

N68-31147# Michigan Univ., Ann Arbor. Meteorology and Oceanography Dept.
THE UTILITY OF SATELLITE CLOUD PHOTOGRAPHS IN OBJECTIVE ANALYSIS OF THE 500-MB HEIGHT FIELD Final Report
Christopher M. Hayden and Aksel C. Wiin-Nielsen Feb. 1968 158 p refs
(Contract CWB-11377)
(PB-177880)

The study was conducted to investigate the feasibility of modifying the 500 mb height field by reference to cloud formations visible in satellite photographs. Three case studies are investigated to illustrate high (North America), medium (Atlantic), low (Pacific) data density regions. It is demonstrated that the tendency technique is successful in improving the forecast guess field, though modestly in areas of good data. Author (USGRDR)

N68-31160# American Meteorological Society, Boston, Mass.
VERTICAL THICKNESS AND STRUCTURE OF CLOUD COVER IN FRONTAL ZONES OVER THE UKRAINE DURING VARIOUS SYNOPTIC PROCESSES [VERTIKAL'NAIA MOSHCHNOST I STRUKTURA OBLACHNOSTI V ZONAKH FRONTOV NAD UKRAINOI PRI RAZLICHNYKH SINOPTICHESKIKH PROTSESSAKH]
I. N. Ponomarenko, A. M. Koshenko, and T. N. Zabolotskaia Bedford, Mass. AFCRL Jan. 1968 32 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeorol. (Kiev), no. 48, 1965 p 67–78
(Contract AF 19(628)-3880)
(T-R-561; AD-667412)

The relation between the intensity of total radiation at the surface of the earth and the thickness of St and Sc clouds is investigated. Nomograms are plotted which permit the thickness of St and Sc layers to be determined with adequate accuracy. The nomograms are used to compute the coefficients of the total extinction of radiation by clouds and to derive the relationship of these coefficients with the altitude of the sun and the thickness of the cloud layer. Author (TAB)

N68-31375# RAND Corp., Santa Monica, Calif.
AN ANNOTATED BIBLIOGRAPHY OF DYNAMIC CLOUD MODELING
F. W. Murray Mar. 1968 41 p refs
(Contract E-37-67(N))
(RM-5582-ESSA; AD-671113)

The document contains a selective bibliography, with informative abstracts of papers related to the numerical simulation of cloud dynamics, including significant works from the Russian and Chinese. Some representative works have been included that model clouds as idealized bubbles or plumes. However, the emphasis is on models involving the solution of hydrodynamic and thermodynamic equations by numerical methods using a digital computer. Cloud microphysics, laboratory studies of convection, and field observations are in general excluded. Several works are listed primarily for their historical interest, including those that introduce the basic thermodynamic equations of water in clouds, the term pseudo-adiabatic, the parcel and slice methods of analysis, and the concept of entrainment. Author (TAB)

N68-31432# Arizona Univ., Tucson. Inst. of Atmospheric Physics.
DETECTION OF HAIL BY MEANS OF DOPPLER RADAR
Louis J. Battan and John B. Theiss 1 May 1968 24 p refs
(Grants NSF GP-5539; NSF GA-1431)
(SR-24)

The doppler spectrum obtained by means of a vertically-pointing X-band pulsed doppler radar may yield information on the size distribution of hail in the free atmosphere. It is concluded that the quantity Λ in the size distribution curve for hail, $N = N_0 e^{-\Lambda D}$ is sometimes more than twice the values 2.27 or 2.93 cm^{-1} proposed by earlier investigators. It is also shown that when both rain and hail are present the variance of the doppler spectrum may exceed 20 $m^2 m sec^2$. Author

N68-31438# Weather Bureau, Silver Spring, Md.
OPERATIONS OF THE WEATHER BUREAU
15 May 1968 239 p

The Weather Bureau, under the Environmental Science Services Administration, has a vast operating program. Its personnel are found at approximately 400 facilities within the 50 states, at 14 overseas stations, and on 20 ships at sea. Altogether the Bureau has about 5,000 full-time employees working in meteorological and hydrologic operations. Meteorological program activities, hydrologic forecast activities, and field engineering programs are described. Within this framework, all of the operating functions and service

programs of the Weather Bureau are considered. Appendices to this report include a listing of stations with identifiers, a tabular summary of facilities and service programs at each station, and a very brief description of the Weather Bureau's administrative organization. Author

N68-31451# Deutscher Wetterdienst, Offenbach am Main (West Germany).
THE EFFECT OF AN INTERMEDIARY AIR LAYER ON METEOROLOGICAL SURFACE TEMPERATURE MEASUREMENTS WITH RADIOMETERS [DER EINFLUSS EINER LUFTZWISCHENSCHICHT AUF METEOROLOGISCHE OBERFLAECHENTEMPERATURMESSUGEN MIT RADIOMETERN]
Dieter Lorenz Aug. 1967 25 p refs In GERMAN; ENGLISH summary
(T-497-I-203) CFSTI: HC$3.00/MF$0.65

The influence of an air layer between target and radiometer in airborne surface temperature measurements is investigated experimentally for altitudes up to 8,000 ft above ground. Calculations made by use of a special radiation chart agree well with the measurements, although the spectral regions of the chart and the radiometer are a little different. Therefore, a simple correction chart for the influence of an air layer of 3,000 ft is calculated using this radiation chart. The agreement between the values of the correction chart and those measured with the radiometer is satisfactory. Author

N68-31470# Army Electronics Labs., Fort Monmouth, N. J.
STRATOSPHERIC WIND OBSERVATIONS BETWEEN 20° NORTH AND 20° SOUTH OF THE EQUATOR
Emily M. Frisby Apr. 1968 54 p refs
(ECOM-2960; AD-670924)

This report presents results of an analysis of four years of stratospheric wind data for stations throughout the tropics at levels between 22 and 31 kms. A comparison is made between the periodicities inherent in the data for these four years (1962-1966) and those found in the data of an earlier period (1959-1962). Identification of stratospheric wind regimes for a series of latitudes at specific heights makes possible operational planning for considerable periods ahead. Results of the study are presented diagrammatically with a view toward facilitating the task of the operational planner. Author (TAB)

N68-31493# Finnish Meteorological Office, Helsinki.
ON THE STRUCTURE OF WIND SPEED IN FINLAND
Seppo Huovila 1967 20 p refs *Its* Contrib. no. 69
CFSTI: HC$3.00/MF$0.65

Mean values and periodic dirunal variation of wind speed in Finland are tabulated for various periods between 1917 and 1965; and graphs depict results from three Finnish observatories. Statistics are included for wind maxima and minima, and relation between peak gust speed and hourly mean wind speed is discussed. Wind speed, temperature, and solar radiation are shown for each month for various time periods. M.W.R.

N68-31608# Pennsylvania State Univ., University Park.
RESEARCH IN FOUR-DIMENSIONAL DIAGNOSIS OF CYCLONIC STORM CLOUD SYSTEMS Final Scientific Report, Nov. 1964–Nov. 1967
Edwin F. Danielsen and Rainer Bleck Oct. 1967 109 p refs
(Contract AF 19(628)-4762)
(AFCRL-67-0617; AD-670847)

The report consists of two parts: (1) by E. F. Danielsen on the flow and trajectories in a developing wave cyclone as derived from hand analyses on equivalent potential virtual temperature surfaces; (2) by R. Bleck on numerical methods for computing moist isentropic trajectories. Danielsen shows that anticyclonic flow and trajectories predominate in the developing cyclone, with the colder air in advance of the cyclone descending and turning anticyclonically into the storm, while the warmer moist air ascends and predominantly turns anticyclonically away from the storm. The colder dry air turning into the cyclone produces cloudless layers under the moist ascending flow. Precipitation generated in the latter flow evaporates in the colder dry air and cloud layers merge. As the colder, now moist, air approaches the cyclone it ascends and is turned cyclonically around to the rear of the cyclone where it then descends again. The analyses are made by hand because it is impossible to generate the analogue of the Montgomery stream function on moist isentropic surfaces. Bleck discusses two numerical methods for constructing isentropic trajectories which include the release of latent heat. He also shows the resultant trajectories, omega fields, latent heat patterns, individual moisture changes, potential vorticity changes and divergence fields for a developing wave cyclone. Author (TAB)

N68-31657# Texas Univ., Austin. Atmospheric Science Group.
A THREE-DIMENSION NUMERICAL STUDY OF THE TEXAS COAST SEA BREEZE
Ronald D. Mc Pherson Aug. 1968 254 p refs
(Grant NSF GA-367X)
(Rept.-15)

The effect on the Texas coast sea breeze of irregularities in the coast line, specifically the effect of Galveston Bay, is examined by means of a three-dimensional mathematical model which is essentially an extension of an earlier two-dimensional model developed by Estoque. A two-dimensional test version of the model is subjected to an extensive series of numerical experiments in order to gain some insight into the characteristics of the model and into its response to variations in some of the modelling assumptions. It is demonstrated that computationally stable solutions can be obtained for periods up to 72 hours. It is also shown that the model is extremely sensitive to variations in the mathematical parameterization of the eddy exchange processes above the boundary layer, and that the formulation of the eddy exchange processes in the boundary layer under stable temperature stratification is inadequate. However, the model simulates many of the observed features of the sea breeze, including intensity and discussions, the sea breeze convergence line, and the clockwise rotation of the horizontal winds with time. Author

N68-31687# Missouri Univ., Columbia. Dept. of Atmospheric Science.
A STUDY OF EVAPORATION
Kare Utaaker 1 Dec. 1967 48 p refs
(Grant CWB-WBG-37)
(PB-177748) CFSTI: HC$3.00/MF$0.65

The energy exchange at the earth's surface is a fundamental problem in micrometeorology. Irrespective of the kind of surface the main components in the heat budget can be written Rn = G + H + epsilon E +-- where: Rn is the net radiation, i.e. net shortwave and longwave radiation exchange between the surface and the atmosphere; G is the sensible heat flow into or out of the sub-surface soil (or water); H is the transfer of the sensible heat to or from the air; and epsilon E is the exchange of latent heat by evaporation or condensation of water at the surface (epsilon is the latent heat of vaporization (cal gr-1) and E is the amount of evaporated or condensated water (gr)). Author (USGRDR)

N68-31731# Environmental Science Services Administration, Silver Spring, Md. Environmental Data Service.
STANDARD DEVIATION OF MONTHLY AVERAGE TEMPERATURE
H. C. S. Thom Apr. 1968 26 p refs
(EDS-3; PB-178309) CFSTI: HC$3.00/MF$0.65

Originally the charts of standard deviation were prepared for obtaining confidence intervals for normals of monthly average temperature and for indirect approximations of frequencies and quantiles of various related temperature functions. Later the charts served as the basis for estimating the normals or means of monthly degree days, also a temperature function. The application to estimation of quantiles of temperature functions is quite general, and it may be expected that many variations of this application will develop, especially where quick approximations to climatological statistics are needed. The standard deviations used in preparing the charts were estimated from World Meteorological Organization standard 30-year records (1921–1950) at some 150 first-order stations of the U.S. Weather Bureau. Author (PB)

N68-31837# Weather Bureau, Washington, D. C. Office of Hydrology.
METEOROLOGY OF MAJOR STORMS IN WESTERN COLORADO AND EASTERN UTAH
Robert L. Weaver Jan. 1968 84 p refs
(WBTM-HYDRO-7; PB-177491)

The 42 most intense general storms in eastern Utah and western Colorado since 1899 are studied in relation to the observed or estimated broadscale upper air circulation patterns and sources of moisture. The report summarizes individual analyses of the storms. Storms are typed by reference to the behavior of the 500-mb patterns. The role of upper Lows in transporting moisture is emphasized. Indices are developed which evaluate storm moisture, temperature and influence of topography. The relative importance to the precipitation sequence of peak moisture versus proximity of upper Lows or troughs is compared. Moisture source regions are related to storm type and season. Local topographic effects are summarized by upper wind direction. Other relationships between various factors are discussed. Author (USGRDR)

N68-31953# Weather Squadron (20th), San Francisco, Calif. 96525
CLIMATE OF CAMBODIA
May 1968 69 p *Its* Ist Weather Wing Special Study 105–15
(AD-670553)

First Weather Wing Special Study 105-15, Climate of Cambodia, was prepared primarily as a planning aid to assist First Weather Wing units in providing basic climatic data for Cambodia. Information contained in this publication is based on climatic averages and should not be construed as a forecast. Author (TAB)

N68-32086*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METEOROLOGICAL RESULTS FROM MULTISPECTRAL PHOTOMETRY IN AIRGLOW BANDS BY THE OGO-4 SATELLITE
Guenter Warnecke, Edith I. Reed, Walter B. Fowler, Earl R. Kreins (AF Environ. Tech. Appl. Center), Lewis J. Allison et al July 1968 28 p refs
(NASA-TM-X-63299; X-622-68-267) CFSTI: HC $3.00/MF $0.65 CSCL 04B

The presence or absence of clouds, an indication of cloud top heights, and variations of surface albedo have been correlated with observations made at several different wavelengths in the visible spectrum. These were made at night, with and without moonlight, by an airglow photometer aboard the OGO-4 satellite during August 1967 through January 1968. The wavelength regions studied were approximately 50A bands centered at 3914A, 5577A, 5893A, 6225A, and 6300A, and in the energy range of 10^{-7} to 10^{-3} ergs $cm^{-2}sec^{-1}$ A^{-1} $ster^{-1}$. It was found that observations at 3914A outside the auroral zone were strongly influenced by light returned through Rayleigh and Mie scattering in the lower atmosphere and the presence of high clouds, but were only slightly sensitive to changes in surface albedo. At longer wavelengths, Rayleigh and Mie scattering become less important and variations in surface albedo and presence of low clouds are readily apparent. This technique has a high potential for meteorological applications in providing cloud information on the night side of the earth. Author

N68-32098# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut fuer Physik der Atmosphaere.
SYNOPTIC-AEROLOGICAL ANALYSES OF COLD FRONTS OF VARIOUS TYPES [SYNOPTISCH-AEROLOGISCHE ANALYSEN VON KALTFRONTEN VERSCHIEDENEN TYPS]
Friedhold Weber May 1968 104 p refs In GERMAN; ENGLISH summary
(DVL-737; DLR-FB-68-29) CFSTI: HC $3.00/MF $0.65

Atmospheric conditions during cold front passages are studied. Numerous observations and recorded data from the surface and from the free atmosphere have been used to analyse the behaviour of various meteorological parameters during the passage of different types of cold fronts so that the existing classification of cold fronts could be confirmed and completed. Author

N68-32170 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 92, NO. 1: RESULTS OF THE SYNOPTIC SERVICE DURING 1968. DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb), BERLIN READINGS, AND BRIEF SCIENTIFIC ARTICLES [METEOROLOGISCHE ABHANDLUNGEN. BAND XCII, HEFT 1: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1968. TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb), BERLINER MESSWERTE UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Richard Scherhag et al Jan. 1968 311 p refs In GERMAN
CFSTI: $3.00

Synoptic meteorological observations presented contain daily weather charts issued by the Institute for Meteorology and Geophysics at Berlin University for January 1968. Measurements were taken at ground level, 300 mb, and 500 mb and cover mostly the North Atlantic–European Region as well as some local Berlin observations. Included are also the following studies: (1) The Skane storm of October 17–18, 1967; (2) daily snow depths in Berlin from 1892 through 1967; and (3) the Central Europe warm air push of January 14, 1968. Transl. by G.G.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-31044# Bell Telephone Manufacturing Co., Antwerp (Belgium).
ELDO FUTURE PROGRAMS. PROJECT NO. 2: LOCALIZATION AND GUIDANCE FOR FUTURE VEHICLES. PRELIMINARY STUDIES NO. 2.2 AND 2.3. PART 1: ILUSTRATIVE MISSION ANALYSIS
31 Jul. 1965 78 p Work Performed for ELDO by a Governmental Working Group
CFSTI: HC $3.00/MF $0.65

A basic network of radio guidance stations which would cover the future needs of the ELDO organization for the launching of European scientific and applications satellites is defined. Three major categories of problems are considered: perigee or low orbit injection, apogee or high orbit operation, and long range tracking.

Installation of two radio stations one at Gove, Australia, and the second in French Guyana should cover the requirements of such missions. Author (ESRO)

N68-31070*# Analytic Sciences Corp., Reading, Mass.
DESIGN OF STRAPDOWN GYROSCOPES FOR A DYNAMIC ENVIRONMENT Semiannual Report, Dec. 1967–May 1968
Arthur A. Sutherland, Jr., William S. Beebee, and Arthur Gelb 15 Jul. 1968 75 p refs
(Contract NAS12-508)
(NASA-CR-86082; TR-101-3; SAR-2) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The work accomplished in a continuing study of strapdown gyroscope design is summarized. Three common pulse torquing techniques for strapdown gyros are described. The important considerations in choosing a rebalance scheme are reviewed and the relative advantages of the three approaches are discussed. Compensation of limit cycling binary torqued gyros is treated with the goal of providing a better closed loop response. A discussion of the dithered binary gyro is presented, illustrating limit cycle determination and closed loop characteristics. The ternary pulse rebalanced gyro is analyzed using describing functions. Closed loop sinusoidal transfer characteristics are obtained and the effect of random signals at the logic input is investigated. A brief discussion of the proposed gyro and system error simulation is presented and attention is given to gimbal misalignments resulting from angular rates about the output axis. Author

N68-31090*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF AN EVALUATION TECHNIQUE FOR STRAPDOWN GUIDANCE SYSTEMS Interim Scientific Report
E. F. Hitt and F. G. Rea 13 Feb. 1968 210 p refs
(Contract NAS12-550)
(NASA-CR-86086) CFSTI: $3.00 CSCL 17G

An evaluation technique for strapdown guidance systems designed for unmanned interplanetary missions was developed. This technique provides a measure of system performance on each mission being examined. In addition, the technique is useful in evaluation of competitive systems, as an aid in preliminary design of conceptual systems, and for determination of research needed to improve system performance. Cost-effectiveness for the problem is defined with cost equal to the weight of the guidance system and effectiveness equal to the probability of the guidance system operating correctly. The effectiveness probability is defined to be the appropriate combination of the probabilities of failure due to guidance system unreliability, failure due to insufficient midcourse fuel, and failure due to missing the target by more than a prescribed distance. Using this cost-(or weight-) effectiveness model, several penalty functions were developed. These may be broken into two categories: those which hold effectiveness or probability constant and consider weight as the penalty and those which hold weight constant and consider the ineffectiveness or probability of failure as a penalty. This eliminates dollar cost as a parameter but combines power, reliability, and accuracy by considering their effects on total guidance system weight. Author

N68-31124# Bell Telephone Manufacturing Co., Antwerp (Belgium).
ELDO FUTURE PROGRAMS. PROJECT NO. 2: VEHICLES. PART 2, VOLUME B (2) PRELIMINARY STUDY NO. 2.2: GENERAL STUDY ON RADIOGUIDANCE
31 Jul. 1965 106 p refs In FRENCH and ENGLISH Work performed for ELDO with contrib. by ACEC
CFSTI: HC $3.00/MF $0.65

Errors in the field of radio guidance are considered, e.g. errors due to: physical parameters; station calibration; noise and dynamics of the radio link from spacecraft station; bandwidth optimization; tropospheric turbulence, atmospheric refraction and ionosphere. Author (ESRO)

N68-31218# Ferranti, Ltd., Edinburgh (Scotland). Inertial Systems Div.
ATTITUDE REFERENCE SYSTEMS
G. G. Leckie [1968] 11 p Presented at the 1st Ann. Meeting of the Brit. Interplanet. Soc., Southampton, 23–25 Apr. 1968
CFSTI: HC $3.00/MF $0.65

The degree to which the accuracy requirements for guidance and control of modern space vehicles have been met are demonstrated in this description of the 'Black Arrow' attitude reference systems. Simplified block diagrams of guidance system gimbal servoloop, and gyrocompassing to North are given. A comparison is made with the ELDO program attitude system throughout the report. ESRO

N68-31220# British Hovercraft Corp., Ltd., East Cowes (England).
THE BLACK ARROW CONTROL SYSTEM
L. R. Bannister and C. A. Hookey [1968] 35 p Presented at the 1st Ann. Meeting of the Brit. Interplanet. Soc., Southampton, 23–25 Apr. 1968
CFSTI: HC $3.00/MF $0.65

The notation of the control system elements has been developed to give, as nearly as possible, a self explanatory system. This system has to cope with the following effects: external disturbances (wind, thrust alignment etc.), fuel slosh, and structural vibrations. Theoretical stability studies have been carried out of first and second stage lateral stability and roll and attitude control. The control system and its reliability testing are described in detail. ESRO

N68-31222# Bell Telephone Manufacturing Co., Antwerp (Belgium).
ELDO FUTURE PROGRAMS. PROJECT NO. 2: LOCALIZATION AND GUIDANCE FOR FUTURE VEHICLES. PART 2, VOLUME B (1) PRELIMINARY STUDY NO. 2.2: GENERAL STUDY ON RADIOGUIDANCE
31 Jul. 1965 129 p refs In FRENCH and ENGLISH Work performed for ELDO with contrib. by ACEC
CFSTI: HC $3.00/MF $0.65

Classification terminology of errors in the field of radio guidance is discussed. Geometrical errors, followed by a complete analysis of sources of errors in instrumentation which leads to internal calibration systems which almost completely reduce errors from this source, are also discussed in detail. Author (ESRO)

N68-31277*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A NAVIGATION AND TRAFFIC CONTROL TECHNIQUE EMPLOYING SATELLITES. VOLUME 1: SUMMARY Interim Report
David D. Otten Dec. 1967 162 p refs
(Contract NAS12-539)
(NASA-CR-86049; TRW-08710-6012-R000, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 17G

User hardware, satellites, and ground stations were considered for use in a navigation and traffic control system for Atlantic coverage for large aircraft, general aviation aircraft, and marine craft. The navigation technique was designed for accommodating nontransponding users, and the overall system was capable of expansion into a worldwide network without additional operational or equipment requirements on the users. An error analysis was made of all operation modes, critical test areas were defined, and rate and capacity of the system for traffic control were determined. Estimates were made for costs of hardware making up the navigation subsystem of the satellite and the ground station

network, as well as for hardware costs to various classes of users. Modulation techniques for ranging were studied, breadboards of several antenna designs were tested, and an industry survey of user state-of-the art was made. M.W.R.

N68-31278*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A NAVIGATION AND TRAFFIC CONTROL TECHNIQUE EMPLOYING SATELLITES. VOLUME 2: SYSTEM ANALYSIS Interim Report
David A. Conrad Dec. 1967 268 p refs
(Contract NAS12-539)
(NASA-CR-86050; TRW-08710-6012-R000, V. 2) CFSTI: HC $3.00/MF$0.65 CSCL 17G

Satellite constellation and ground station network analyses are documented, and the results of tracking accuracy and error analyses are presented. Based on coverage and accuracy considerations, the constellation selected consists of two orbit planes with eight satellites in each plane. Measurement error sources are discussed, and the related types of measurement correlation are identified as time serial correlation, interstation correlation, and intersatellite correlation. Overall navigation accuracy was analyzed for the complete worldwide system and for an interim system covering the North Atlantic. Navigation equations are derived for four classes of users: a relatively sophisticated user, such as a supersonic transport, desiring maximum accuracy; a user with more limited computational facilities than the SST, but who requires a reasonably high degree of accuracy; the simplest class of user, who will use charts and make hand calculations to compute position; and a user who is provided additional data to make his computations near trivial. Supporting data are presented on orbital perturbations and stationkeeping, eclipse histories, and injection node selections. Computer programs are included. M.G.J.

N68-31279*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A NAVIGATION AND TRAFFIC CONTROL TECHNIQUE EMPLOYING SATELLITES. VOLUME 3: USER HARDWARE Interim Report
Nathan Estersohn and Art Garabedian Dec. 1967 232 p refs
(Contract NAS12-539)
(NASA-CR-86051; TRW-08710-6014-R000, V. 3) CFSTI: HC $3.00/MF$0.65 CSCL 17G

User equipment studies indicated the feasibility of navigation and traffic control techniques employing satellites for a manually operated user configuration, for automatic self-contained user hardware for both SST and general aviation, and for automatic ground-aided user hardware. The basic NAVSTAR system, its key elements, and major functions are described; and the antenna, receiver, preprocessor, computer, and display and control subsystems are treated in detail. BINOR code, pulse compression, and fixed-tones preprocessor designs were considered; and computer sizing analysis was studied, and surveys of an aerospace computer and an electronic calculator/desk-top computer were made. New technology is mentioned, including methods of reducing memory costs. Ranging modulation studies for position location using a navigation satellite system are detailed. M.W.R.

N68-31280*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF A NAVIGATION AND TRAFFIC CONTROL TECHNIQUE EMPLOYING SATELLITES. VOLUME 4: GROUND STATION AND SATELLITE Interim Report
David D. Otten Dec. 1967 207 p refs
(Contract NAS12-539)
(NASA-CR-86052; TRW-08710-6015-R000, V. 4) CFSTI: HC $3.00/MF$0.65 CSCL 17G

Requirements are considered for the ground system to support an air traffic navigation system consisting of a two-orbit network with eight synchronous satellites in each orbit. A network of supporting ground stations is proposed, with the distribution of tracking sites designed for high accuracy. The ground system also includes telemetry receiving and command sites, and a master computation system to receive data from tracking sites and compute orbital data for transmission to the satellites. Location of the various stations, their functional descriptions, and some preliminary cost estimates are presented. Navigation signal generation, the L-band transmitter for the navigation sygnal system, and communications (voice) links are considered. Details relating to satellite design include structural requirements, mass properties, electrical integration and power, antenna subsystems, antenna despun and attitude control, propulsion, and thermal control. System and subsystems reliability are discussed; as are a survey of very stable oscillators, satellite oscillator reset, and command requirements and telemetry measurements. M.W.R.

N68-31413*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
FUTURE ASPECTS OF SUPERSONIC TRANSPORT NAVIGATION
Robert Jon Pawlak [1967] 10 p refs
(NASA-TM-X-61039) CFSTI: HC $3.00/MF$0.65 CSCL 17G

Requirements studies have been completed and a five-year program plan has been developed for research leading to the technology required for an advanced supersonic transport integrated avionics system. The study results, long-range plan, and work presently underway in the specific areas of navigation and guidance mechanisms in a hybrid fashion which makes most effective use of each. The most important constituent tasks being pursued are a passive navigation and traffic control satellite system, use of inertially derived translation information to improve significantly the all-weather landing capability, flight test verification monitoring tests helpful to strapdown system design, sensor level redundancy concepts in strapdown inertial navigation systems, fuel-optimum climb trajectory studies, and laser gyro research for aircraft applications. Author

N68-31502*# Scripta Technica, Inc., Washington, D. C.
NAVIGATION AND TRAFFIC CONTROL OF SHIPS AND AIRCRAFT WITH THE AID OF SATELLITES. 3: PROPOSALS FOR REMOTE POSITION FINDING BY UTILIZING SATELLITES [NAVIGATION UND VERKRSKONTROLLE VON SCHIFFEN UND FLUGZEUGEN MIT HILFE VON SATELLITEN. TEIL 3): PROJEKTE DER FREMDORTUNG MITTELS KINSTLICHER SATELLITEN]
H. C. Freiesleben NASA Aug. 1968 12 p refs
(Contract NASw-1694)
(NASA-TT-F-11750) CFSTI: HC $3.00/MF$0.65 CSCL 17G

Several American companies are studying the measurement of distance between satellite and a craft as basis for determining the position of the latter. One of the proposals also contemplates direction finding from the satellite. The measurements are to be initiated and evaluated by stations of a world-wide ground organization. This will enable the organization to control the position of all monitored aviation and maritime craft which will thus be relieved from plotting their own bearings. Author

N68-31771*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE OPTICAL GUIDANCE SYSTEM FOR RENDEZVOUS
Charles L. Wyman *In its* Proc. of the Space Opt. Tech. Conf., Vol. 1 Apr. 1966 p 103-114 refs (See N68-31759 19-07)

The program to develop automatic guidance and docking equipment is reviewed. A study of laser and optical techniques has established that a laser radar and tracker is practical for this purpose. The progression of the work from a feasibility study through breadboard design to test prototype is outlined, and plans

for testing the prototype on a rendezvous simulator and in aircraft are discussed. The prototype optical guidance system uses both pulsed and CW radar techniques. A laser beacon is used on the target vehicle for acquisition. Image dissectors generate angular information for acquisition and tracking. Another possible concept using laser beam steerers on the chase vehicle is also briefly discussed. K.W.

N68-31782# Wissenschaftliche Gesellschaft fuer Luft- und Raumfahrt, Stuttgart (West Germany).
MEASUREMENT OF ROTARY VELOCITIES AND DIRECTIONS IN NAVIGATION BY MEANS OF OSCILLATING SYSTEMS [DIE MESSUNG VON DREHGESCHWINDIGKEITEN UND DREHRICHTUNGEN IN DER NAVIGATION DURCH SCHWINGENDE SYSTEME]
A. Karolus 30 May 1967 31 p refs In GERMAN
CFSTI: HC $3.00/MF $0.65

Reviewed are such characteristics as sensitivity, stability, service life, effective signal, and interferences in oscillating systems for measuring rotary velocities and directions. The discussion centers around experimental results that were obtained with tuning fork gyroscopes in the frequency range from 800 Hz to 1600 Hz. Materials, the temperature coefficient, mechanical tolerances, the torsional system, the electromagnetic transducers, and the Coriolis effect are discussed. Transl. by K.W.

N68-31938*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A CELESTIAL ATTITUDE MEASUREMENT INSTRUMENT FOR PROJECT SCANNER
T. M. Walsh, William C. Dixon, Jr., Dwayne E. Hinton, and James A. Holland Washington Aug. 1968 43 p refs
(NASA-TN-D-4742) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The Project Scanner horizon-definition experiment required independent spacecraft attitude measurements with an accuracy (1σ) of 0.016°. This requirement led to the development of a celestial attitude measurement procedure using a unique star-mapping technique. Successful application of this technique required the detection and identification of stars in a +3 visual magnitude A0 spectral class. Star mapping was accomplished by use of a passive optical instrument consisting of a telescope, a coded reticle, and a photomultiplier. The telescope was mounted with its optical axis normal to the Scanner spacecraft principal spin axis. Spin motion about this axis caused star images to transit the reticle. Each star transit was sensed by the photomultiplier as two sequences of coded pulses that were telemetered to a ground receiving station. The amplitudes of the received pulses were proportional to the photometric magnitude of the stars, and the time separation of two pulse groups generated by a single star transit were related to the elevation angle of the star within the field of view of the telescope. Time separations of pulse groups generated by different stars were related to their azimuth angle separations. Total-angular-separation computations were used to identify the stars. Author

N68-31957*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATTITUDE DETERMINATION OF THE SPIN-STABILIZED PROJECT SCANNER SPACECRAFT
T. M. Walsh, Jean C. Keating, and Dwayne E. Hinton Washington Aug. 1968 62 p refs
(NASA-TN-D-4740) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The Scanner experiment required continuous knowledge of the spacecraft celestial attitude with a one-sigma accuracy of 0.016°. The basic measurements used to obtain attitude information were sighting times of stars viewed by the star mapper on the Project Scanner vehicle. Each star sighting produced coded-pulse sequences the amplitudes of which were related to the visual magnitude of the star. The times of occurrences of these pulse sequences were related to the angular separation between a pair of stars. These angular-separation data were used to identify the sighted stars. The right ascension and declination of the identified stars and their transit times were used to identify the values of a set of parameters in an assumed model of the vehicle dynamical equations of motion. These vehicle motion parameters were then used to determine the vehicle celestial attitude as a function of time. A brief discussion of the star mapper is presented and the technique used to detect transit times of stars from the coded signals of the star mapper is described. A complete description of the star identification and parameter identification procedures is presented. Author

N68-31965# Air Force Missile Development Center, Holloman AFB, N. Mex.
CENTRAL INERTIAL GUIDANCE TEST FACILITY
Robert E. Beale May 1968 39 p
(MDC-TR-68-48; AD-670826)

This report describes the methods used to test accelerometer subsystems. These tests, designated standard tests, are designed to determine the magnitude, stability, and repeatability of the coefficients of an assumed performance model. The accelerometer output is described in terms of the acceleration inputs along three orthogonal axes and the coefficients are estimated from the test data. The description of methods includes data reduction techniques and a description of the specialized test equipment used to obtain the data (indexing stands and centrifuges). The tests described are 2-point tests, 4-point tests, multi-point tests, parameter variation tests, and centrifuge tests with methods for determining stability and repeatability defined. A typical test program is outlined and the offices to be contacted to initiate a test program are identified. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see 24 Physics, Atomic, Molecular, and Nuclear. For related information see also 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-30988# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
STUDY OF THE MULTICHANNEL SYNTHESIS METHOD FOR SPACE-TIME NEUTRONICS
Weston M. Stacey, Jr. Nov. 1967 69 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6742; WMS-6) CFSTI: HC $3.00/MF $0.65

A multichannel space-time synthesis model for the calculation of nonseparable reactor transients is developed from a variational principle which admits expansion functions that are discontinuous in space and time. In each of many spatial regions, the flux during each interval of time is expanded in known functions of position with unknown expansion coefficients. The accuracy of the method, and its superiority with respect to the conventional single-channel space-time synthesis method, are demonstrated by several numerical examples. Author (NSA)

N68-30992# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
CALCULATION OF FUEL PLATE FLUX AND CENTRAL TEMPERATURE
W. B. Jordan 15 Mar. 1968 18 p
(Contract W-13-109-ENG-52)
(KAPL-M-6914; WBJ-6) CFSTI: HC $3.00/MF $0.65

A simple graphical procedure is given for calculating peak heat flux and peak central temperature in a fuel plate. Results are compared with those computed by a more elaborate method and show discrepancies of less than 1%. Author (NSA)

N68-31006 Florida Univ., Gainesville.
COMPUTATIONAL TECHNIQUES AND PERFORMANCE CRITERIA FOR THE OPTIMUM CONTROL OF NUCLEAR SYSTEM DYNAMICS
Jagdish K. Saluja (Ph.D. Thesis) 1966 165 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-13160

Two systems are considered: nuclear reactor system, nuclear rocket engine system. For the first system, three problems are analyzed: (1) The neutron density or reactor power is transferred from one steady state condition to another with a quadratic constraint on control rod movement. By varying the operating time and placing an inequality constraint on reactivity, a form of minimum time control is obtained. (2) Integral of quadratic form of error in desired neutron density is minimized with quadratic integral constraint on control rod movement. (3) A fixed configuration optimum closed-loop control system is realized by letting control rod movement be a proportional plus integral function of neutron density error. For the case of the nuclear rocket engine system, only a quadratic constraint on total reactivity is considered. Dissert. Abstr.

N68-31043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE DOUBLE CONTAINMENT TANTALUM-STAINLESS STEEL SNAP-8 BOILER
L. W. Gertsma, P. A. Thollot, D. W. Medwid, and A. J. Sellers Washington 1968 15 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo. 13–16 Aug. 1968
(NASA-TM-X-52452) CFSTI: HC $3.00/MF $0.65 CSCL 18N

A major problem in the development of the SNAP-8 space power system has been the mercury boiler, principally due to the incompatibility of containment materials with mercury. As an approach to the solution to this basic problem, a boiler utilizing tantalum for the mercury-containment material was designed for the the SNAP-8 system and tested for 1445 hours. Because of safety requirements, the design incorporated double containment of the mercury, which in effect separated the radioactive primary loop fluid from the mercury by two metal walls and buffer region filled with NaK. Design features which allowed the use of a tantalum tube within a stainless steel (SS) tube are discussed. These include both an oval SS containment tube and a bellows to allow for differential thermal expansion and the need for bimetallic joints. Thermal design of the boiler is described. The overall operating history and a comparison of test results with predicted performance indicate the boiler fulfilled its design requirements. Author

N68-31111# Brookhaven National Lab., Upton, N. Y.
FAILURE OF COBALT-60 RADIATION SOURCES
J. I. Wagner and J. S. Milau Feb. 1968 39 p refs
(BNL-50099) CFSTI: HC $3.00/MF $0.65

About 217,000 curies of ^{60}Co Radiation Sources, BNL Mark I type, were shipped from Brookhaven National Laboratory to Honolulu, Hawaii, in February 1967 for use in the Hawaii Development Irradiator. When the shipping casks were opened in the irradiator pool, a black "cloud" was reported to rise out of the casks. Radioactivity was reported at the pool ion exchanger. The surface of the pool reached an activity of about 12 mr/hr. The probable causes of this activity release and means to avoid future similar occurrences are suggested. It is tentatively concluded that the major factor causing the extra-source activity was corrosion of the source cladding which penetrated to the cobalt core. The corrosion was probably due to the combined effect of low pH, dissolved metallic salts and lack of oxygen. Cobalt-60 was the only radioisotope detected. A replacement shipment of sources was made using modified shipment techniques developed during this investigation. Even though the cask was located on the weather deck of the ship and exposed to severe hurricane conditions, the receipt of the sources in as-shipped condition proved the efficacy of the modifications. Author (NSA)

N68-31164*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SNAP-8 POWER CONVERSION SYSTEM ASSESSMENT
George M. Thur Washington 1968 14 p refs Presented at the Intersoc. Energy Conversion Eng. Conf., Boulder, Colo., 13–16 Aug. 1968
(NASA-TM-X-52464) CFSTI: HC $3.00/MF $0.65 CSCL 18N

Details are given on the SNAP-8 system, the original design philosophy, and the present status of SNAP-8. An assessment is made of major components comprising the power conversion system. In addition, an estimate of the growth potential of the power conversion system is made using present hardware and what might be expected if major hardware changes were made. Author

N68-31189# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
CAVITATION PHENOMENA IN LIQUID METALS
F. G. Hammitt Dec. 1967 14 p refs Presented at a Seminar at Electricite de France, Centre de Recherches et d'Essais de Chatou, Paris, Nov. 1967
(Grant NSF GK-1889)
(TR-01357-1-T; PB-177298) CFSTI: HC $3.00/MF $0.65

The problems of cavitation in liquid metals are reviewed, including the various applications where this has been important starting with the early 1950s. At present cavitation and related phenomena are of pressing importance in sodium-cooled fast neutron breeder reactors, and the problems involved are discussed. Detailed theoretical considerations wherein reactor temperature sodium might be expected to differ from ambient temperature water are reviewed, and the relatively scattered applicable engineering results from component tests which have been published are considered. Author (USGRDR)

N68-31227# Reactor Centrum Nederland, Petten.
EXPERIMENTAL STUDY OF DIFFERENT TECHNIQUES OF ANALYZING REACTOR NOISE MEASURED BY A NEUTRON COUNTER
Erdinc Türkcan and Jan B. Dragt Jun. 1967 38 p refs
(RCN-75) CFSTI: HC $3.00/MF $0.65

Three groups of techniques for analyzing reactor noise measured by means of a neutron counter are reviewed: methods concerned with second order moments of the probability distribution of neutron counts, viz. evaluation of Feynman's variance-to-mean ratio, Bennett's delta variance and the autocorrelation function; a third order moment analysis; some p-methods, viz. the evaluation of the probabilities for zero, one and an even number of counts in given time intervals. The reactor and the experimental set up are described. Formulas are given that have been used for the analysis of the data according to the mentioned techniques as well as the computer programs used for the analysis. In the last part, the results and some conclusions are presented. ESRO

N68-31248# Academia R.P.R., Bucharest. Institutul de Fizica Atomica.
STUDY OF THE ACTIVATION PHENOMENA IN THE COOLING-WATER OF THE VVR-S REACTOR

E. Ionescu and Z. Alexan 1968 8 p refs
(IFA-FR-59)

Radioactive isotopes in the reactor cooling-water are obtained from the cooling water itself, cooling water impurities, fuel cladding, fuel material, structural material, and control rods and their impurities. Lists of radioisotopes present in the cooling-water giving the abundance, source, radiation, and energy are presented. Samples of gamma-spectrometry measurements are presented. NSA

N68-31249# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

RECENT DEVELOPMENTS IN THE SEFOR EXPERIMENTAL PROGRAM

L. Noble (GE, San Jose, Calif.), G. R. Pflasterer (GE, San Jose, Calif.), C. D. Wilkinson (GE, San Jose, Calif.), and L. Caldarola Aug. 1967 32 p refs Presented at the Intern. Conf. on Fast Critical Expt. and Their Analysis, Argonne, Ill., 10–13 Oct. 1966 Sponsored by EURATOM
(KFK-649; CONF-661019-12)

Three types of experiments are performed: static tests, oscillator tests, and transient (including super-prompt critical) tests. In the static tests, the power, flow, and inlet temperature are changed in such a way that the reactivity effect associated with a change in fuel temperature due to power only, the coolant temperature coefficient, the combined power and temperature coefficient, and the flow coefficient is determined. Three types of oscillator tests are analyzed. Transient tests are analyzed for various total reactivity worths and ejection rates at different power levels. Such tests allow the reactivity-energy coefficient to be determined over a wide range of fuel temperatures. A description of each test and of the power-temperature domain over which each test is performed based on current SEFOR design capabilities is presented. Analytical models for the various feedback effects, together with recently calculated coefficients consistent with the SEFOR mockup tests in ZPR-3 are given. Methods developed for the evaluation of the feedback coefficients in the analytical model from the results of the static, oscillator, and transient tests are described. The proposed instrumentation, data acquisition system and data processing techniques are also described. Author (NSA)

N68-31287# Japan Atomic Energy Research Inst., Tokyo.

ON THE MICROSTRUCTURE CHANGE INDUCED BY CENTER MELTING AND THE FORMATION OF CENTRAL VOIDS IN POWDER COMPACTED UO_2 FUEL

Tadashi Kubota, Yoshinobu Seki, and Shuichiro Takahashi Jun. 1968 16 p refs Transl. into ENGLISH from J. Japan Inst. Metals, v. 31, no. 4, Apr. 1968 p 406–412
(NSJ-TR-124) CFSTI: HC $3.00/MF $0.65

The microstructure changes induced by center melting and the formation of central voids in powder compacted UO_2 fuel were studied by center-line heating in order to obtain some valuable informations for interpreting the data of in-pile tests which were done in parallel with this experiment. The main results obtained were as follows: (1) Single crystalline columnar grains and equi-axed grains were grown in the region molten during the heating process and solidified by the subsequent cooling process, while columnar grains having lenticular voids were grown in the region kept in the solid state throughout the experiment. (2) Both types of columnar grains showed different growth patterns depending upon the change in the extent of the molten zone. When the molten zone was large, large single crystalline columnar grains were grown in the central region, while small columnar grains having lenticular voids were grown in the region surrounding the large central grains. When the molten zone was small, large columnar grains having lenticular voids were grown in the central region. (3) The central voids were grown not only by melting-down but also by shrinkage of powder compact associated with sintering when the temperature of central region was high enough to induce the sintering of UO_2. Author

N68-31344 Illinois Univ., Urbana.

THE EFFECT OF FUEL DIAMETER ON THE DOPPLER TEMPERATURE COEFFICIENT OF REACTIVITY IN FAST REACTOR SYSTEMS

Laurence Bernard Miller (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-11884

A theoretical method for the analysis of the Doppler effect was developed and applied to determine the effect of size of fuel elements on the Doppler coefficient of a typical fast breeder reactor. Emphasis was placed on the elimination of the approximations and assumptions. Several additions to Monte Carlo theory were developed. The temperature derivative of the absorption rate was formulated as an integral involving the collision density times. A technique was developed for determining variation of Doppler coefficient when the size of fuel elements in a fast reactor is changed without changing the fuel and coolant volume fractions. A rigorous mathematical theory was formulated to eliminate calculation of optical distances from the point of each collision to each of the region boundary points through which the neutron passes on its way to the next collision. Continued-fraction expansions of the Doppler broadening functions were adapted to provide fast and accurate evaluation of the neutron cross sections at each neutron energy. Dissert. Abstr.

N68-31384# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.

ANISOTROPIC COLLISION PROBABILITIES IN GENERAL CYLINDRICAL GEOMETRY

L. Amyot Brussels Jun. 1968 26 p refs
(EUR-3937.E) CFSTI: $3.00

Based on the work of Takahashi for one-dimensional systems, a general formalism is presented for anisotropic collision probabilities in general cylindrical geometry. The method is based on an expansion in spherical harmonics of fluxes, sources, cross sections and collision probabilities. The resulting expressions for the zeroth and first order collision probabilities are simply related respectively to the classical isotropic collision probabilities and the directed probabilities used by Benoist in his thesis on the diffusion coefficient. Author

N68-31463# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

REMARKS ON SOME ASPECTS OF FBR THERMAL AND HYDRAULIC ANALYSIS: CORE OPTIMIZATION, SAFETY AND SODIUM BOILING

R. C. Noyes 1968 33 p Seminar presented at the Casaccia Nucl. Studies Center and Bologna Computer Center
(RT/ING(68)7-PRV-r-(67)2) CFSTI: HC $3.00/MF $0.65

The contents of seminar presented at the Casaccia Nuclear Studies Center and Bologna Computer Center in January 1967 are summarized. The seminar includes a survey on: Fast Breader core optimization methods; Fast Breeder Reactor safety problems and accidents analysis methods; sodium boiling aspects such as steady state and transient experiments; theories and models; results of voiding studies; and some possible effects of sodium boiling researches on fast breeder core design. Author

N68-31465# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

A DISCUSSION OF METHODS FOR THEORETICAL ANALYSIS OF COOLANT EJECTION IN FBR'S, INCLUDING A DESCRIPTION OF THE ETNA CODE

R. C. Noyes 1968 40 p refs
(RT/ING(68)10-PRV-r-(68)6) CFSTI: HC $3.00/MF $0.65

Approaches to the problem of transient two-phase flow in sodium cooled reactors are identified as quasi-steady-state methods, homogeneous representations, and the separated-phase

model. Important assumptions in the formulation of these analytic two-phase flow models are outlined with respect to hydrodynamics, thermodynamics and heat transfer, fluid physical properties, geometric considerations and mathematical treatments. Some computer programs are named which reflect these considerations. The ETNA computer program to calculate coolant ejection based on the separated-phase model is described. Among several features of the program are the provision for calculating liquid superheating effects, capability for calculating hydrostatic pressure variations, and improved input and output routines. A number of development and improvement items for the ETNA program are listed and briefly explained. A flow chart of the basic ETNA program and the program nomenclature are included. D.H.B.

N68-31505# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

ABSORPTION CROSS SECTION MEASUREMENTS IN SAMPLES CONTAINING BURNABLE POISONS

T. Ferrari, R. Martinelli, and E. Santandrea 1968 24 p refs

(TR/FI(68)8) CFSTI: HC$3.00/MF$0.65

Consideration is given to the use of burnable poisons for long-life reactivity control in power reactor cores when a high irradiation level is required for long operational time without fuel replacement. In order to obtain information about the cross section dependence on the grain size and the irradiation level, a research program was developed to experimentally investigate the value of absorption cross section of samples containing burnable poison with different material composition and grain size, at zero life and after irradiation. The experimental method is discussed along with the equipment used to conduct the experiment. The results of measurements made with unirradiated and irradiated samples are included. B.S.D.

N68-31527# Stuttgart Univ. (West Germany).

JET THRUST FORCES RESULTING FROM A BREAK IN THE REACTOR COOLING PIPE

Lutz T. Kayser Mar. 1968 12 p refs

(AGRR-TB-14) CFSTI: HC$3.00/MF$0.65

This publication reports on a literature search and experimental investigation on the jet thrust forces resulting from a break in a hot water pipe below saturation. The simulation of breaks with an opening time of 10^{-5}s resulted in an empirical law for the initial thrust coefficient C_F. $C_F = 0.5\ (1 + Pv/Ps)$ where Pv is the vapor pressure and Ps is the pipe internal pressure. Author

N68-31578# Oak Ridge National Lab., Tenn.

BUILDUP OF THE CHARGED RADIATION COMPONENT IN A SHIELD

B. S. Sychev [1967] 8 p refs Transl. into ENGLISH from JINR-P9-3269 Rept.

(ORNL-TR-1912; JINR-P9-3269) CFSTI: HC$3.00/MF$0.65

Solution of an equation of charged particle transport in the semi-infinite space is presented. The main assumptions, in writing the equation, are the neglect of the secondary cascade processes under the action of charged particles and of the Coulomb scattering. The way obtained to solve this equation allows one to calculate, comparatively easy, the distribution function of the charged particle flux density, when the source density distribution is given. Author (NSA)

N68-31580# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).

SHORT RESIDENCE EXTRACTORS: A REVIEW OF THEIR CHARACTERISTICS AND PERFORMANCES IN NUCLEAR FUEL REPROCESSING

J. Centeno and R. De Witte Mar. 1967 28 p refs

(NP-17366; ETR-191)

One of the difficulties encountered in the aqueous reprocessing of high-burnup fuels is the high radiolytical degradation of the solvent used (TBP-kerosene) as extractant in the first decontamination cycle. Different types of short-residence extractors, which can be regarded as possible solutions for decreasing the radiolytical degradation of the solvent, are briefly described and analyzed according to their construction and operational chracteristics. The usefulness of short-residence extractors for recovery and separation of fission products is also pointed out. It is suggested that an experimental program be started in order to gain experience in this field and to be in a position to face this problem of radiolytical degradation from the technological side. Author (NSA)

N68-31603# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch.

HANDBOOK OF EXPERIMENTAL CRITICALITY DATA, PART 2, CHAPTERS 5 AND 6

F. Abbey, comp. 1968 124 p refs

(AHSB(S)Handbook-5, Pt. 2)

Criticality data are tabulated for: single ^{235}U cores moderated by hydrogen and single Pu cores moderated by hydrogen. The results for highly enriched systems are categorized according to: unreflected spheres of aqueous UO_2F_2 and $UO_2(NO_3)_2$ and spherical systems reflected with water and polyethylene; aqueous cylindrical systems—both reflected and unreflected; reflected unreflected aqueous parallelepiped cores; uranium metal cores diluted with lucite and with lucite–graphite; and annular cylindrical aqueous cores. The results for low and intermediate enrichment systems are categorized as: bare aqueous cores of spherical, cylindrical, and rectilinear parallelepiped configurations; single material reflected systems; and composite reflectors. Criticality data for heterogeneously poisoned aqueous systems are tabulated. Pu fueled aqueous systems are categorized according to spherical, cylindrical, or parallelepiped. NSA

N68-31635# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

ANALOG-HYBRID DYNAMIC SIMULATION OF THE FFTF REACTOR AND HEAT TRANSPORT SYSTEM

C. D. Flowers and L. H. Gerhardstein Apr. 1968 101 p refs

(Contract AT(45-1)-1830)

(BNWL-707) CFSTI: HC$3.00/MF$0.65

A mathematical model has been developed for investigating the dynamic response and control characteristics of the Fast Flux Test Facility (FFTF) Reactor and heat removal systems. The model was developed for solution on the analog-hybrid computer facility at Pacific Northwest Laboratory (PNL). The mathematical modeling techniques used to simulate each system component are discussed in detail, and sample transient results are presented. Prospective uses of the simulation are also discussed. One complete heat removal circuit (out of four) is simulated, and the total heat is accounted for by a multiplying factor. The reactor simulation includes point kinetics with temperature feedbacks, single-node representation fuel, coolant, leakage, and reflector regions, and inlet and outlet mixing plenums. Multinode heat exchanger models are employed to represent the intermediate and air-dump heat exchangers. The system model also includes simulation of coolant transport time lags, sodium pumps, motors, electromagnetic clutches, air fans, and sodium and air hydraulics. Author (NSA)

N68-31636# Argonne National Lab., Ill.

PROBLEMS OF THE CONSTRUCTION OF A HIGH POWERED FAST REACTOR

A. I. Leipunskii, V. V. Orlov, M. S. Pinkhasik, M. F. Troyanov, and A. A. Rineiskii 1968 18 p refs Transl. into ENGLISH from the Russian Presented at IAEA Intern. Working Group on Fast Reactors Meeting, Vienna, 5–7 Mar. 1968

(ANL-TRANS-588; CONF-680316-1) CFSTI: HC$3.00/MF$0.65

The design parameters for the BN-350 reactor are presented and compared to design parameters for high power fast reactors of 500 to 1000 MW(e). Design and construction problems described for 500 to 1000 MW(e) fast reactors include: fuel and fuel elements; core and shields; heat transfer system; refueling; liquid sodium pumps; and steam generators. NSA

N68-31656# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.

PHYSICS VERIFICATION PROGRAM, PART 2 Final Report

M. N. Baldwin, R. H. Clark, and J. E. Rogers Apr. 1968 123 p refs

(Contract AT(30-1)-3647)

(BAW-3647-7, Pt. 2) CFSTI: HC $3.00/MF $0.65

Presented are descriptions of uranium dioxide water moderated, multirod critical assemblies; calibration of radiation detectors, fission chambers, and ionization chambers; performance of rhodium wire, aluminum dyprosium wire, and use of aluminum alloys for neutron flux measurement and as control rods; effects of concrete shielding thickness. Analyses of critical study of aluminum clad uranium dioxide, and measurement of neutron flux distributions are also included. NSA

N68-31705# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

APPLICATION OF DYNAMIC PROGRAMMING TO THE OPTIMAL CONTROL OF XENON-POWER SPATIAL TRANSIENTS

Weston M. Stacey, Jr. 31 Jul. 1967 20 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6725) CFSTI: HC $3.00/MF $0.65

Dynamic programming is applied to obtain a computing algorithm for the optimal control of xenon-power spatial transients in a nuclear reactor. In order to limit the number of possible states in the flux-xenon-iodine-temperature-control phase space which must be considered, the time interval is divided into a few decision intervals, and the possible states are computed by a branching type calculation. A FORTRAN program is described which solves the optimal control problem for xenon-power transients in three spatial dimensions, with thermal feedback. The techniques are demonstrated for a shutdown transient on a realistic reactor model. Author (NSA)

N68-31915# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente.

ANALOG COMPUTER MODEL FOR STEAM-COOLED FAST REACTOR WITH DIRECT CYCLE [ANALOGRECHENMODELL FUER DAMPFGEKUEHLTE SCHNELLE REAKTOREN MIT DIREKTKREISLAUF]

W. Frisch and G. Woite Dec. 1967 59 p refs In GERMAN

(KFK-657; EUR-3693.d)

An analog computer model for the simulation of the dynamics and kinetics of steam cooled fast breeder reactors is given. Included are models for neutron kinetics, heat transfer from fuel element to coolant, coolant pressure differentials across the core, and reactivity feedback effects. NSA

N68-31927# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).

CALCULATION OF THE HETEROGENEOUS INTEGRALS ALLOWING FOR A NONSYMPTOTIC MODERATOR FLUX AND A NONUNIFORM TEMPERATURE DISTRIBUTION IN FISSIONABLE FUEL [ZUR BERECHNUNG VON HETEROGENEN RESONANZINTEGRALEN UNTER BERUECKSICHTIGUNG EINES NICHTASYMPTOTISCHEN MODERATORFLUSS UND EINER NICHTUNIFORMEN TEMPERATURVERTEILUNG IM SPALTSTOFF]

H. Tschirky Mar. 1968 72 p refs In GERMAN

(EIR-132)

The multigroup transport equations for determination of heterogeneous resonance integrals are formulated in cylindrical geometry in terms of lethargy. The formulation allows for nonasymptotic moderator fluxes and a nonuniform fission product temperature distribution. Lie series methods are used for flux expansions in the multigroup formulation. Applications of the formulation are discussed; a sample problem is solved. A formulation of the Doppler broadened resonance cross section is formulated according to Breit–Wigner techniques; the NR- and WR-approximations, solutions to the integral and integro-differential transport equations. Monte Carlo methods and equivalence theory are considered as possible methods for solution to the integral equations arising in the cross section calculations. NSA

N68-31976# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

BIBLIOGRAPHY ON THE BURN-UP OF NUCLEAR FUELS

A. R. Palmer and R. N. Whittem Mar. 1968 43 p refs

(AAEC/TM-449)

Information of a general nature on burnup determination, including surveys and reviews of the literature, is given. References to destructive and non-destructive methods of burnup determination are tabulated. Methods of calculation are listed with the exception of named burnup codes which are separately listed. Some references to the effects of burnup on reactivity are included. The references are taken from Nuclear Science Abstracts (up to January 1968) and the A.A.E.C. report library. Author (NSA)

N68-32019# Mound Lab., Miamisburg, Ohio.

CALCULATED DOSE RATES FOR PLUTONIUM-238 DIOXIDE

C. T. Meyer, H. F. Anderson, and J. B. Kahle 22 May 1968 37 p refs

(Contract AT(33-1)-GEN-53)

(MLM-1460) CFSTI: HC $3.00/MF $0.65

A computerized program was developed to determine the gamma dose rates from plutonium dioxide as a function of mass, density, distance from the material, and time elapsed after purification. The program gives the gamma dose rate from the bare material as well as the dose rate attentuated by components of a typical glove box. Literature values were selected for the gamma energies of the seven isotopes in the plutonium dioxide, their relative abundance, and the linear absorption coefficients in various shielding materials. A spherical source was assumed with corrections for self-absorption. The 17-keV X-ray component of ^{238}Pu contributes 99 and 93% of the total dose rate from bare and acrylic resin-shielded material, respectively, and practically zero percent of the dose rate from the iron and lead-shielded material. The ^{208}Tl component, however, contributes up to 20% of the total dose rate from the iron- and lead-shielded plutonium dioxide after 10 yr. A means for evaluating the neutron dose rate was also included. Author (NSA)

N68-32020# Atomics International, Canoga Park, Calif.

SAFETY CHARACTERISTICS OF POLONIUM-210

C. A. Willis, E. T. Bramlitt, R. B. Paulson, and K. L. Rooney 20 Dec. 1967 124 p refs Prepared for Sandia Corp.

(Contract AT(29-1)-789)

(SC-CR-67-2801) CFSTI: HC $3.00/MF $0.65

The safety characteristics of ^{210}Po are investigated by evaluating the potential hazards from a 500,000-Ci source in a launch-pad abort. A launch-pad abort model is developed largely on the basis of Project Pyro data. Available experimental data and theoretical models are used to estimate polonium evaporation rates. The attachment of polonium to particles and smokes in the abort

environment are evaluated using coagulation theory. Inhalation radiation doses are calculated using the International Commission on Radiological Protection model. The quantities of dusts that need to be injected into the cloud to provide various degrees of dose reduction are estimated. It was concluded that experimental data concerning polonium attachment to particles was needed to permit a realistic assessment of the hazards. Author (NSA)

N68-32021# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.

INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-13

May 1968 436 p refs

(Contract W-7405-ENG-26)

(ORNL-NSIC-44) CFSTI: HC $3.00/MF $0.65

An annotated bibliography on nuclear safety literature and information is given. The information is categorized according to the following: general safety criteria; siting of nuclear facilities; transportation and handling of radioactive materials; aerospace safety; accident analysis; reactor transients, kinetics, and stability; fission product release, transport, and removal; sources of energy release under accident conditions; nuclear instrumentation, control, and safety systems; electrical power systems; containment of nuclear facilities; plant safety features; radiochemical plant safety; radionuclide release and movement in the environment; environmental surveys, monitoring and radiation exposure of man; meteorological considerations; operational safety and experience; and safety analysis and design reports. Author and subject indexes are included. NSA

N68-32022# Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.

DETAILED STUDY OF THE RADIOACTIVE DECAY KINETICS OF Pu 238 AND RELATED PARENT AND DAUGHTER NUCLIDES. PART 1: HELIUM GENERATION, THERMAL POWER, AND SPONTANEOUS FISSION

Harold J. Garber 8 Jun. 1967 75 p refs

(Contract AT(30-1)-3731)

(NUMEC-3731-4.5-6, Pt. 1; TID-24373, Pt. 1) CFSTI: HC $3.00/MF $0.65

A complete study of the radioactive decay kinetics of the seven parent nuclides present in ^{238}Pu isotopic power fuel was conducted. The kinetics survival equations for ^{236}Pu, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, and ^{237}Np, their 104 daughters, and helium generation were developed, with the constants rounded off to 12 significant figures, starting with one mole of parent nuclide in each case. For making the calculations the radiochemical and nuclear physics values included in Dzhelepov and Peker's treatise were used. The kinetics equations were then used to develop radioactive decay kinetics values up to 2,000 years of time lapse subsequent to nuclide processing and fuel fabrication. These data are assembled in tabular form in a generalized fashion so that the results can be readily applied to a calculation of the instantaneous cumulative helium and specific thermal power for any ^{238}Pu type fuel whose initial assay and analysis is known. For immediate cardiac pacemaker design purposes, the helium buildup and specific thermal power are presented in tabular and chart form for SRP "Typical" ^{238}Pu product having an analysis of 0.00012% ^{236}Pu, 80.5% ^{238}Pu, 14.9% ^{239}Pu, 2.9% ^{240}Pu, 0.8% ^{241}Pu, 0.1% ^{242}Pu, and 0.5% ^{237}Np. Author (NSA)

N68-32023# Atomics International, Canoga Park, Calif.

SCORE: AN AUTOMATED CROSS SECTION EVALUATION SYSTEM

C. L. Dunford, R. F. Berland, and R. J. Creasy (IBM, Palo Alto, Calif.) 15 Jan. 1968 75 p refs

(NAA-SR-MEMO-12529; ENDF-108) CFSTI: HC $3.00/MF $0.65

The ability to analyze and evaluate the increasing amount of new neutron cross section information is a vital part of the effort to design economic nuclear reactors. By application of computer graphics techniques, one may supply the cross section evaluator with the tools which are necessary. By permitting man–computer interaction through computer graphics, both the rapidity and quality of evaluations will be greatly increased. A brief description of a prototype system, SCORE, is presented. Methods tested during the development of this prototype evaluation system have widespread general applications as well. Author (NSA)

N68-32038# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

SUBCOOLED PRESSURE GRADIENT CALCULATIONS IN PWR SYSTEMS FOLLOWING PRIMARY COOLANT LOOP BREAKS

V. T. Berta Mar. 1968 52 p refs

(Contract AT(10-1)-205)

(IDO-17243) CFSTI: HC $3.00/MF $0.65

Rapid breaks in the primary coolant loop of a PWR system can cause pressure gradients which may initially damage the core, preventing reactor scramming or inhibiting emergency core cooling. An approximation method has been developed to determine the magnitude and duration of the pressure gradients. The method is an empirical formulation involving generalized system and component dimensions and fluid properties and has been compared to results from the LOFT Semiscale Blowdown Test Program. In applying the method to a reactor vessel and connecting piping, the controlling parameters are: cross-sectional areas for coolant flow in the upper plenum, core region, lower plenum, and the inlet and outlet pipes; lengths of the plenums, core, and the coolant pipe from the vessel to the break; the size of the pipe break; and the system pressure and the coolant temperatures and corresponding sound velocities in various regions. The method consists of evaluating a series of equations for each of the two plenums within the vessel. Author (NSA)

N68-32040# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.

ALUMINUM ION PLATING OF URANIUM–MOLYBDENUM ALLOY FAST-BURST REACTOR ELEMENTS

R. T. Bell 6 Jun. 1968 27 p refs

(Contract W-7405-ENG-26)

(Y-1617) CFSTI: HC $3.00/MF $0.65

Ion plating of thin (<0.2 mil) aluminum coatings on fast-burst reactor parts fabricated from uranium-10 percent molybdenum alloy was evaluated as a method of protecting the alloy from oxidation and as a means of containing the fission products. A number of core rings were plated with nickel while other rings were ion plated with aluminum so that a comparison between the two coatings could be made. During the ion plating of aluminum and subsequent heat treatment, certain uranium-aluminum intermetallic compounds (UAl_2, UAl_3, and UAl_4) were formed. During the process of testing to destruction, these rings encountered fissions in excess of 10^{17} and temperatures in excess of 700°C during which the nickel plating spalled severely while the aluminum and the uranium-aluminum intermetallics remained adherent to the alloy. Author (NSA)

N68-32083# Instituto de Asuntos Nucleares, Bogota (Columbia). Div. Reactor.

DETERMINATION OF SEVERAL PARAMETERS IN THE NUCLEAR REACTOR IAN-R1 [DETERMINACION DE ALGUNOS PARAMETROS EN EL REACTOR NUCLEAR IAN-R1]

Edmundo Sandoval, Gustavo Ramirez, Antonio Barragan, and Manuel Casabianca [1967] 91 p refs in SPANISH

(IAN-R-1-2)

A description of the IAN-R1 research reactor is given. Neutron flux measurements are discussed; flux profiles are given for several core positions; calculational procedures are described. Reactivity measurements for the reflector, core, and experimental facilities are discussed. Reactor sensitivity to reactivity coefficients is determined. Measurement of the temperature coefficient of reactivity is detailed. NSA

N68-32084# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
IRRADIATION TESTING OF FUEL FOR THE MARK 1 CORE OF THE ARGONNE ADVANCED RESEARCH REACTOR
M. J. Graber and G. W. Gibson Apr. 1968 62 p refs
(Contract AT(10-1)-1230)
(IN-1160) CFSTI: HC $3.00/MF $0.65

The irradiation testing and evaluation of a 37 wt % low-density UO_2 stainless steel dispersion fuel is reported. This fuel was originally proposed for the long fuel cycle operation of the Argonne Advanced Research Reactor. The results show that starting density of the fuel can affect the operating life. Author (NSA)

N68-32101# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PLUTONIUM UTILIZATION PROGRAM Technical Activities Quarterly Report, Dec. 1967–Feb. 1968
Apr. 1968 84 p refs
(Contract AT(45-1)-1830)
(BNWL-739) CFSTI: HC $3.00/MF $0.65

Summary information is given on the following: (1) fuel burnup and analysis of radiation effects in plutonium recycle test reactor (PRTR); (2) burnup of plutonium and uranium oxides in PRTR and experimental boiling water reactors (EBWR); (3) effects of neutron irradiation on microstructure of plutonium and uranium oxides; (4) the use of autoradiography for analysis of radiation effects in plutonium and uranium oxides; (5) core loading and reactivity measurements in plutonium recycle critical facility; (6) effects of boron concentration in water on thermal test reactor; (7) effects and analysis of benezeneboronic acid on reactivity of thermal test reactor; and (8) gamma scan analysis of fuel element burnup in EBWR. NSA

N68-32104# United Kingdom Atomic Energy Authority, London (England). Authority Health and Safety Branch.
AHSB REPORTING SYSTEM FOR PLANT FAULTS-PLANT FAULT CODE
E. Parker and R. Roughley 1967 55 p
(AHSB(S) R127) CFSTI: HC $3.00/MF $0.65

A Plant Fault Code is presented for use in conjunction with a punch card system for recording and storing, in the Authority Health and Safety Branch (AHSB), of faults and incidents which occur on UKAEA plants and nuclear reactors. Fault statistics from sources other than the UKAEA may be included when available. Author

N68-32110# Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.
DETAILED STUDY OF THE RADIOACTIVE DECAY KINETICS OF Pu 238 AND RELATED PARENT AND DAUGHTER NUCLIDES. PART 2: DESCRIPTION OF A LONG LIFE RADIOISOTOPIC FUEL WITH FLAT POWER GENERATION CHARACTERISTICS
Harold J. Garber 8 Jun. 1967 38 p refs
(Contract AT(30-1)-3731)
(NUMEC-3731-4.5-7, Pt. 2; TID-24373, Pt. 2) CFSTI: HC $3.00/MF $0.65

The properties of blended ^{238}Pu–^{241}Pu isotopic fuels are discussed, and it is shown that optimum power flattening is achieved at the 35% ^{238}Pu-65% ^{241}Pu composition. The merits of such a fuel in connection with fueling long life medical appliances, including the cardiac pacemaker are demonstrated. Brief mention is also made of the potential application of such a fuel to other RTG devices requiring extended mission periods. Author (NSA)

N68-32111# Atomics International, Canoga Park, Calif.
S8DR TEMPERATURE SWITCH DEVELOPMENT AND TESTING
J. L. Powers 15 May 1968 17 p
(Contract AT(04-3)-701)
(NAA-SR-12038) CFSTI: HC $3.00/MF $0.65

A temperature switch is described which operates in conjunction with a platinum resistance temperature detector to provide the input signals to control the SNAP 8 Reactor. The results of a testing program which demonstrated the suitability of the device for the SNAP Developmental Reactor (S8DR) use are also described. Author (NSA)

N68-32126# Bettis Atomic Power Lab., Pittsburgh, Pa.
FLOT-1: FLOW TRANSIENT ANALYSIS OF A PRESSURIZED WATER REACTOR DURING FLOW COASTDOWN
G. M. Fuls Apr. 1968 48 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-428) CFSTI: HC $3.00/MF $0.65

A description of the FLOT-1 (MO219) digital computer program for the prediction of the flow transient in a multiloop, multibranch, pressurized water reactor resulting from the partial, total, or sequential loss of power to the operating pumps is presented. The most significant parameter in the rate of flow coastdown is the kinetic energy in the pump rotor. A new empirical method of treating the transfer of energy from the pump rotor to the fluid is developed. Accurate prediction of the flow coastdown permits optimization of core power for maximum safe operation. The accuracy of this method of prediction is verified by correlation of predicted results with test data for the PWR at the Shippingport (Pa.) Power Station. Author (NSA)

N68-32155# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
CAINE LIBRARY 51
Carol L. Phillips and Robert L. Seidel Oct. 1967 49 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6738(CLP-1)) CFSTI: HC $3.00/MF $0.65

A new three-group cross section library (CAINE Library 51) has been developed for use on small, high-leakage cores. The library was developed in order to reduce the large reactivity bias which has been observed between small critical experiments and their calculations. The new library consists of epithermal (1/7 fits of FOMENT fast and epithermal cross sections and a thermal cross section treatment based on the Goldman Improved Nelkin water kernel. The fast and epithermal group constants are based on a fuel region critical buckling of 0.01 cm^{-2}. Separate fits exist for fuel regions and for untied structure regions. The library is applicable to high leakage cores containing basically 93% enriched uranium, ^{10}B, Zircaloy and water. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-30995 California Inst. of Tech., Pasadena.
THE DYNAMIC STABILITY OF AN UNBALANCED MASS EXCITER
Lawrence William Hallanger (Ph.D. Thesis) 1967 74 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-14348

The dynamic stability of single- and multi-degree-of-freedom unbalanced mass exciter systems is discussed. A representative set of systems is analyzed numerically, and the results are presented in a figure showing the stability boundary as a function of the system parameters in non-dimensional form. Two distinct types of multi-degree-of-freedom systems are discussed. The first consists of a single oscillator mass that is free to perform planar motion. The second system consists of a series of linear single-degree-of-freedom oscillators with an unbalanced mass exciter mounted on one of them. It is concluded that, in any multi-degree-of-freedom system, an "equivalent" single-degree-of-freedom analysis may be used to examine the stability of the system near any resonance as long as that particular mode is the only one which is being significantly excited. Dissert. Abstr.

N68-31049 Rice Univ., Houston, Tex.
DYNAMIC POLARIZATION OF LIQUID HELIUM 3 BY OPTICAL PUMPING
Harley Hobbard Mc Adams, Jr. (Ph.D. Thesis) 1967 86 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13102

Experiments are described wherein optical pumping of ^3He gas in diffusive contact with ^3He liquid at 0.93°K yields steady state nuclear spin polarization of 0.085 percent in a 20 mm^3 liquid sample and transient polarization of 0.15 percent in a 2 mm^3 sample. The experiments were performed in an applied magnetic field of about 8 gauss, corresponding to a thermal equilibrium polarization of 7×10^{-5} percent. Using the same technique, 2 percent polarization was achieved in ^3He gas at 4 mm pressure and 0.93°K. The ^3He liquid sample is condensed in the tip of a 28 cm long pyrex tube the tip of which is immersed in a pumped ^4He bath at 0.93°K. The pyrex tube connects to a spherical 90 cc pyrex cell at room temperature. Transport equations are derived coupling the spin-lattice relaxation mechanisms in the cold liquid and vapor into the optical pumping process in the room temperature cell. Using these transport equations, equations are derived relating the expected liquid polarization to the parameters of the experiment. These equations indicate improvements in the experimental design that should increase the attainable liquid polarization. Dissert. Abstr.

N68-31071# Arizona Univ., Tucson. Optical Sciences.
A PUPIL COATING FOR QUASI-PERFECT IMAGE FORMATION
B. Roy Frieden 20 Oct. 1967 11 p refs
(TR-21; PB-176973) CFSTI: HC $3.00/MF $0.65

It is found that, despite the finite extent of any real pupil, an absorption coating exists which, when applied to the pupil of an optical system, results in nearly perfect formation of the coherent image. It is suspected that this coating causes a significant loss of total illumination. On the other hand, an 'active' pupil (one for which there is a gain in light flux) would allow the quasi-perfect imagery without any loss in total illumination. When active pupils become a technological reality, this will be a good use for one. Author (USGRDR)

N68-31139 Lehigh Univ., Bethlehem, Pa.
A STUDY OF SOME EXACT SOLUTIONS OF THE EINSTEIN EMPTY SPACE FIELD EQUATIONS
Richard Bruce Hoffman (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-14937

Exact solutions are sought of Einstein's field equations of general relativity for empty space where the metric tensor $g_{\mu\nu}$ is a function of one variable x^1 only. All normal hyperbolic solutions are found; apart from the trivial case of all $g_{\mu\nu}$ being constant, these fall into one of three cases, which are presented. Dissert. Abstr.

N68-31155 New Mexico State Univ., University Park.
PROPAGATION OF ELECTROMAGNETIC WAVES IN A MEDIUM PUMPED BY A TRAVELLING SINUSOIDAL WAVE
Nadackapadath Ninan Mathew (Ph.D. Thesis) 1967 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-12851

This work is a presentation of a study of the propagation of electromagnetic waves in a nonconducting charge-free medium whose permittivity varies in space and time by the action of a pump wave of frequency Ω and propagation vector $\vec{K}$. The wave equation is obtained for the general three dimensional case. The expressions for the electric field within a slab and a semi-infinite medium are found when an electromagnetic wave of frequency ω is incident normally on one face. Waves at frequencies $\omega + n\Omega$ will be reflected and transmitted. From the conditions for the continuity of the electric and magnetic fields at the boundaries, the reflection and transmission coefficients are evaluated. Dissert. Abstr.

N68-31197 Explosives Research and Development Establishment, Waltham Abbey (England).
SONIC BANG SIMULATION BY LINEAR EXPLOSIVE CHARGES
S. J. Hawkins and J. A. Hicks [1967] 11 p refs
CFSTI: $3.00

Linear explosive charges for use in simulating sonic boom are described in terms of producing conditions for field scale experimentation, and some records of the waveforms obtained from typical Mark I and Mark II simulants are illustrated. The amount of superimposed noise is much less for the Mark II simulant than for the Mark I. Mark I simulants are considered most applicable to study the effects of sonic boom on buildings, structures, or other systems that respond to acoustic energy in the low audio and sub-audio frequency ranges; while the Mark II is most applicable to studies of physiological, psychological, and sociological effects on man and animals. Orientation effects and region of acceptable simulation are discussed for both types, and the theory of blast from extended explosive charges is mentioned. M.W.R.

N68-31333 Maryland Univ., College Park.
CALCULATION OF FUNCTIONALS OF MATRICES ARISING IN SOLID STATE PHYSICS AND QUANTUM CHEMISTRY
Phillip Ben-Zion Abraham (Ph.D. Thesis) 1966 245 p
Available from Univ. Microfilms: HC $11.05/MF $3.20 Order No. 67-6263

A large variety of physical and chemical systems are characterized by the repetition of identical units. The periodic structure of these systems allow their handling by similar mathematical methods. It is the purpose of this thesis to present certain techniques for the evaluation of analytic functions of matrices associated with such systems. The method consists of Poisson-type transformations of finite sums, which lead to rapidly converging expressions for the problems considered. Examples related to lattice dynamics and molecular orbital theory are discussed. Certain restricted sums of perturbation theory are calculated exactly by a method of independent interest. An extensive list of matrices arising from diverse periodic systems, together with their eigenvalues and eigenvectors, is presented. This extends and generalizes results in the literature. Dissert. Abstr.

N68-31399# California Univ., Berkeley.
EXPERIMENTS ON NONLINEAR OPTICS Semiannual Technical Summary Report, 1 Jan.–30 May 1968
Y. R. Shen 30 May 1968 15 p refs
(Contract Nonr-3656(32); ARPA Order 306)
(AD-670615)

Preliminary results on self-trapped filaments in different liquids and liquid mixtures are reported. It is shown that stimulated Raman and Brillouin scattering is probably not responsible for the filament formation. Further work is needed to determine whether Kerr effect or field-induced phase transition is the principal mechanism for self-trapping. Difference-frequency generation in the submillimeter region from quartz and $LiNbO_3$ by beating of two ruby laser beams is reported. The difference-frequency is tunable through thermal tuning of the laser frequencies. This is the first coherent, tunable, far-infrared pulse generator ever constructed.
Author (TAB)

N68-31421# Texas Univ., Austin. Antennas and Propagation Lab.
DETERMINATION OF VIBRATIONAL AND ROTATIONAL ENERGY LEVELS OF WATER VAPOR
David L. Dobbins and Alfred H. La Grone 20 Sep. 1967 123 p refs
(Grant NSF GA-767)
(P-21)

Water vapor absorbs energy in the infrared and visible portions of the electromagnetic spectrum by two methods: Absorption of energy to increase its vibrational energy and/or absorption of energy to increase its rotational energy. Computer programs were written and the vibrational and rotational energy levels for the lower energy levels of water vapor which were calculated are reported.
Author

N68-31509# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
A METHOD FOR CONSTRUCTING CERTAIN AXIALLY SYMMETRICAL EINSTEIN–MAXWELL FIELDS
Z. Perjes 10 Apr. 1968 5 p refs
(KFKI-9/1968)

It is shown that the existing cylindrical static electric and magnetic fields are in a certain linear connection, simplifying the field equations. Furthermore a method is given to translate results of the cylindrical static Einstein–Maxwell theory to the cylindrical stationary free gravitational case and inversely. As an example of the use of this method, the gravitational field of a magnetic dipole is obtained from the Kerr metric.
Author (NSA)

N68-31510# Joint Publications Research Service, Washington, D. C.
PHENOMENON OF ANOMALOUS WATER DESCRIBED
Boris Vladimirovich Deryagin and Nikolay Vladimirovich Churayev 25 Jul. 1968 14 p Transl. into ENGLISH from Priroda (Moscow), no. 4, 1968 p 16–22
(JPRS-45989)

The choice of water as a standard liquid is challenged, and the fact that water is not constant and appears in various forms is considered to substantiate such a challenge. Experiments dealing with the resiliency of water are cited that present new concepts relating to the behavior of liquids. It is suggested that liquids have a memory, and the differences between ice and water are noted. Stable changes in the properties of water are discussed, as are the properties of so-called anomalous water and measurement of its density.
M.W.R.

N68-31528# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Divisions Etudes et Developpements Techniques.
PROCEEDINGS OF THE MARSEILLE CONFERENCE ON OPTICS [COMPTE-RENDU DES JOURNEES D'OPTIQUE DE MARSEILLE]
3 Jan. 1968 152 p refs In FRENCH Meeting held in Marseille, 27 Jun.–2 Jul. 1967
(Rept.-00015/PR/ED) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. STUDY ON FABRICATION OF THIN FILMS WITH A HIGH REFLECTION COEFFICIENT IN THE FAR ULTRAVIOLET M. Guillard p 4–24 refs (See N68-31529 19-15)

2. TECHNICAL PROBLEMS IN FABRICATING INTERFERENTIAL FILTERS B. Saudreau (Soc. d'Etudes et d'Appl. de Vide Optique et Mecan.) p 25–28 refs (See N68-31530 19-14)

3. FABRICATION OF CONCAVE DIFFRACTION GRATINGS ON BERYLLIUM THIN FILMS J. M. Lamenardie p 29–33 refs (See N68-31531 19-15)

4. FABRICATION OF OPTICAL GRATINGS G. Pieuchard (Jobin et Yvon S. A.) p 34–37 refs (See N68-31532 19-23)

5. RELIABILITY OF COMMAND ELECTRONICS OF A MACHINE FOR TRACING OPTICAL DIFFRACTION GRATINGS P. Albertinoli p 38–48 (See N68-31533 19-15)

6. DIFFRACTION GRATING CONTROL METHODS P. Cruvellier (Centre Natl. de la Rech. Sci.) p 49–62 (See N68-31534 19-23)

7. INTERFERENCE GRATING TRACING BY HOLOGRAPHY A. Labeyrie (Paris Obs.) p 63–65 refs (See N68-31535 19-23)

8. STUDY ON THE FABRICATION OF BERYLLIUM MIRRORS M. Guillard p 66–86 (See N68-31536 19-15)

9. FABRICATION OF LITHIUM AND MAGNESIUM FLUORIDE SINGLE CRYSTALS G. Petitjean (Compagn. Gen. d'Elec.) p 88–97 (See N68-31537 19-18)

10. O.N.E.R.A. INFRARED DETECTOR TEST LABORATORY J. Laurent (Office Natl. d'Etudes et de Rech. Aerospatiales) p 98–103 (See N68-31538 19-14)

11. PHOTOCONDUCTING TELEVISION CAMERA TUBE WITH NEAR ULTRAVIOLET IMAGE AMPLIFICATION M. Blamouler (Compagn. Franc. Thomson–Houston) p 104–120 (See N68-31539 19-09)

12. C.N.E.S. INVESTIGATION OF TELEVISION CAMERA TUBES C. L. Guillard p 121–128 refs (See N68-31540 19-09)

13. PHOTOMULTIPLIERS AND IONIZATION CHAMBERS FOR FAR ULTRAVIOLET RADIATION D. Petit (Radiotechnique S. A.) p 130–143 (See N68-31541 19-09)

N68-31532# Jobin et Yvon S. A., Arcueil (France).
FABRICATION OF OPTICAL GRATINGS [FABRICATION DES RESEAUX OPTIQUES]
G. Pieuchard *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 34–37 refs (See N68-31528 19-23)

Improvements to fabrication techniques of interference grating have been made on two specific points: elimination of Lyman ghost images and efficiency of gratings. The origin of Lyman ghost image is discussed. Methods for gaining knowledge of the groove profile are discussed with reference to the value of the wavelength and the value of spacing.
ESRO

N68-31534# Centre National de la Recherche Scientifique, Paris (France). Lab. d'Astronomie Spatiale.
DIFFRACTION GRATING CONTROL METHODS [METHODES DE CONTROLE DES RESEAUX]

P. Cruvellier *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 49–62 (See N68-31528 19-23)

The paper is mainly concerned with control of the efficiency, mean and point to point of diffraction gratings. Test equipment is described. It is shown that concave gratings usually have inhomogeneities so that they are not suited for precise photometric measurements. ESRO

N68-31535# Paris Observatory, Meudon (France).
INTERFERENCE GRATING TRACING BY HOLOGRAPHY [LES RESEAUX HOLOGRAPHIQUES]
A. Labeyrie *In* Centre Natl. d'Etudes Spatiales Proc. of the Marseille Conf. on Opt. 3 Jan. 1968 p 63–65 refs (See N68-31528 19-23)

Large interference gratings are difficult to produce by tracing machines. A new method has been developed using holographic techniques. ESRO

N68-31634# Academy of Sciences (USSR), Moscow.
NECESSITY OF MAKING AN ALLOWANCE FOR THE SYMMETRY OF HELICAL MAGNETIC FIELDS [O NEOBKHODIMOSTI UCHETA SIMMETRII VINTOVYKH MAGNITNYKH POLEI]
G. P. Maksimov and P. A. Cheremnykh 1966 8 p refs In RUSSIAN
(IAE-1259)

The work draws attention to the need to take into account the symmetry of helical magnetic fields, which may arise in investigating magnetic surfaces with the aid of an electron beam as well as magnetic traps having fields of this type. NSA

N68-31685# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON NONSTATIONARY DIFFUSION OF RADIATION IN AN INHOMOGENEOUS MEDIUM
I. N. Minin 25 Mar. 1967 4 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 3, no. 3, 1967 p 345–350
(PB-177579T) CFSTI: HC $3.00/MF $0.65

A method is proposed for the solution of problems on nonstationary diffusion of radiation in an inhomogeneous stationary medium. An example of application of the method to the problem of diffuse light reflection is given. In the theory of nonstationary diffusion of radiation the case when the optical properties of the medium do not change with time is comparatively simple. Application of the Laplace transform turns out to be an effective method for the solution of various problems in this case. The author has shown in /1–3/ that the Laplace time transform of any function characterizing the radiation field is easily found directly from the solution of the corresponding problem for the stationary radiance condition. A homogeneous medium was hence considered. USGRDR

N68-31719
ON THE CONSTRUCTION OF A GENERALIZED LAGRANGE FUNCTION
N. E. Tkachenko [1968] 3 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR, Ser. Fiz. Mat. Nauk (USSR), no. 2, 1968 p 138–141
CFSTI: HC $3.00/MF $0.65

The following problems are examined: (1) the motion of a variable mass system (the absolute velocity of an individual mass is zero) in a medium where the resistance forces are determined by a linear law; and (2) the motion of particles of constant mass in a viscous medium where the resistance forces are determined by a quadratic law. A generalized Lagrange function is constructed for these cases, including dissipative forces. It is shown that Lagrange formalism can be used without introducing additional coordinates and negative resistances. Author

N68-31783# National Research Council of Canada, Ottawa (Ontario).
FOCUSING A MOLECULAR BEAM BY MEANS OF A HETEROGENEOUS MAGNETIC FIELD [O FOKUSIROVANII MOLEKULYARNOGO PUCKHA NEODNORODNYM MAGNITNYM POLEM]
M. I. Korsunskii and I. M. Fogel 1968 16 p ref Transl. into ENGLISH from Zh. Eksper. i Teoret. (USSR), v. 21, no. 2, 1951 p 25–37
(NRC-TT-1312) CFSTI: $3.00

Various types of heterogeneous magnetic fields permitting double focusing of a molecular beam are presented, and the motion of molecules in these fields, taking into account the effect of the force of gravity, are considered. It is shown that by means of a plane heterogeneous magnetic field, considered in this paper, it is possible to make a lens for molecular beams. Author

N68-31857# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
THE CAUSALITY CONDITION AND RELATION BETWEEN BOGOLIUBOV'S AND LEHMANN–SYMANZIK–ZIMMERMAN'S AXIOMATIC [USLOVIE PRICHINNOSTI I SOOTNOSHENIE MEZHDU AKIOMATIKAMI BOGOLYUBOVA I LEMANA–SHIMANCHIKA–TSIMMERMANA]
B. V. Medvedev, M. K. Polivanov and A. D. Sukhanov 1967 17 p refs In RUSSIAN; ENGLISH summary
(ITF-67-38)

Current-like operators Λ_n to clarify the difference between the Bogoliubov and L.-S.-Z. axiomatics and some other problems are discussed. The causality condition is obtained in L.-S.-Z. axiomatics, which is more restrictive than Bogoliubov's microcausality condition written in the adequate form. The results are discussed from the Lagrangian point of view and from the point of view of renormalizability problem in quantum field theory. Author (NSA)

N68-31901# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
OPTICAL ANISOTROPY IN THE REGION OF THE TRANSURANIUM ELEMENTS [OPTICHESKAYA ANIZOTROPIYA IZOMEROV V OBLASTI TRANSURANOVYKH ELEMENTOV]
A. M. Baldin, S. F. Semenko, and B. A. Tulupov 1968 10 p refs In RUSSIAN
(JINR-P2-3738)

Some effects of the optical anisotropy of the transuranium element nuclei and their utilization for determination of the form of isomeric cross sections are discussed. Author (NSA)

N68-31914# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
APPROXIMATE ANALYTICAL SOLUTION FOR EQUATIONS IN PROBLEMS OF QUANTUM MECHANICS [PRIBLIZHENNOE ANALITICHESKOE RESHENIE URAVNENII V ZADACHAKH KVANTOVOI MEKHANIKI]
I. V. Amirkhanov and V. S. Gur'yanov 1968 13 p refs In RUSSIAN
(JINR-P4-3741)

An attempt was made of developing approximate analytical wave functions. A certain F(r) function was reduced to a Fourier series. The Fourier series of any arbitrary quadratically integrable function converges in the mean linear integral equations. Such series are rapidly convergent when F(r) and its initial derivatives are

continuous. The developed function was used to obtain the approximate analytical solutions for the scattering problem and for a system of integro-differential equations. NSA

N68-31936# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
RESEARCH IN OPTICAL COHERENCE Final Report
Robert S. MacMillan, Gregory O. Young, and James D. Arnett Dec. 1967 17 p refs
(Grant AF-AFOSR-188-67)
(USCEE-264; AFOSR-68-0880; AD-670532)

Major accomplishments include the writing of a fundamental paper on optical system optimization and the development of a transcoherence theory for intensity (as well as for fields). An experimental program was initiated. An optical system was simulated by a computer. Arbitrary aperture size, shape, and amplitude and phase shading can be introduced into the computer, which generates the corresponding far-field pattern (i.e., image). The image may then be read out and/or photographed. The improvement achieved by transcoherence-function maximization can then be shown experimentally as well as theoretically. Author (TAB)

N68-31950# Royal Aircraft Establishment, Farnborough (England).
THE HALO ARRANGEMENT FOR THE CONTINUOUS MEASUREMENT OF THE MICROSTRUCTURE OF CLOUDS AND FOGS BY THE SMALL ANGLES METHOD [OREO'NAYA USTANOVKA DLYA NEPRERYVNOGO IZMERENIYA MIKROSTRUKTURY OBLAKOV I TUMANOV METODOM MALYKH UGLOV]
V. I. Bukatyi and S. S. Khmelevtsov May 1968 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), v. 1, 1968 p 91–94
(RAE-LIB-TRANS-1301) CFSTI: HC $3.00/MF $0.65

The equipment and methods for the continuous measurement of the microstructure of clouds and fogs by the small angles method are described. Results are given of the measurement of the distribution function and these are compared with the data from simultaneous measurements of the microstructure of artificial fogs by flux traps. Author

N68-31952# University of Southern Calif., Los Angeles. Dept. of Physics.
COMPUTATION OF THE EFFECTIVE SOLID ANGLE IN ANGULAR-CORRELATION EXPERIMENTS USING GAS TARGETS
E. Bar-Avraham and L. C. Lee Apr. 1968 23 p
(Contract AT(04-3)-136)
(USC-136-138) CFSTI: HC $3.00/MF $0.65

A simple method is presented to calculate the effective solid angle for a correlation experiment using a gas target. This method permits one also to calculate the angular spread for each angle setting. A computer program using this method is presented in the appendix. Author (NSA)

N68-31963# Gottingen Univ. (West Germany). Third Inst. of Physical Sciences.
INTERACTION BETWEEN AIR FLOW AND AIRBORNE SOUND IN A DUCT. VOLUME 3: SUMMARY REPORT Final Report, Feb. 1965–Jan. 1966
F. P. Mechel, P. A. Mertens, and W. M. Schilz Wright-Patterson AFB, Ohio AMRL Nov. 1967 46 p refs
(Contract AF 61(052)-666)
(AMRL-TR-67-120, V. 3; AD-670576)

The report briefly summarizes experiments during 1963-64 on the interaction between subsonic airflow and airborne sound in a duct. Also summarized are the results of the following four experiments conducted in 1965. The first experiment investigates the effect of the wall impedance on the stability and phase velocity of boundary layer waves. Measurements revealed a step in the dispersion curve of the flow velocity; this agrees with the dispersion curve of the sound velocity for a transition from capactive to inductive wall impedance. The second experiment investigates a flow boundary layer modified by sinusoidal suction (as opposed to stationary suction) through a porous plate imbedded in the wall of a duct. The alternating motions present in the suction elements excite boundary layer disturbances which may lead to a quicker transition into turbulence as compared to stationary suction. The third experiment was performed to improve the stability of a flow boundary layer by the application of an appropriate wall impedance. It was concluded that the real part of the impedance must be below 0.2 rho c. The final and most detailed experiment investigates the reflection coefficient of cross-sectional area changes and apertures in a tube with sound superimposed on an air flow. Smooth cross-sectional transitions show no acoustical or flow losses, whereas abrupt area changes cause flow separation, turbulence, and flow losses, all of which are associated with acoustic losses. These losses are described as an ohmic resistance which is added to the impedance of the transition. Author (TAB)

N68-31970# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SOME PROBLEMS OF THE THEORY OF BUBBLE GROWTH AND CONDENSATION IN BUBBLE CHAMBERS [NEKOTORYE VOPROSY TEORII ROSTA I KONDENSATSII PUZYR'KOV V PUZYR'KOVYKH KAMERAKH]
L. G. Tkachev 1968 17 p refs In RUSSIAN
(JINR-P13-3726)

The causes are analyzed of the divergence of theoretical and experimental values of the growth rate and that of condensation of bubbles in liquid hydrogen. It is shown that, while considering the heat transfer between a bubble and the liquid, one cannot consider the adjacent layer to be thin and the liquid heat capacity to be the constant independent of the temperature. Taking into account these factors the corrections appear, which can be compared with the value of the divergences observed. Author (NSA)

N68-31975# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
ANALYTICITY PROPERTIES OF AN EXPONENTIAL OPERATOR
N. N. Bogolubov, Jr. 1967 36 p refs
(ITF-67-20)

A separable Hilbert space H is considered. The quantity L is a self-adjoint operator whose domain D(L) is everywhere dense in H. It is said that L is an operator with discrete spectrum if there exists in H the complete set of eigenvectors of L. An operator T of this kind is considered, and the complete orthonormal set of its eigenvectors is denoted, and the corresponding eigenvalues which are real are denoted. The case when for any $t > 0$ the series turns out to be convergent is discussed. NSA

N68-32028# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
THEORY OF NONEQUILIBRIUM PROCESSES IN STATISTICAL MECHANICS. 3: INTEGRAL EQUATION FOR DENSITY MATRIX AND THE ROLE FREE HAMILTONIAN IN THE EVOLUTION OF DYNAMICAL SYSTEM [K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. 3: INTEGRAL'NOE URAVNENIE DLYA MATRITSY PLOTNOSTI I ROL'SVOBODNOGO GAMIL'TONIANA V EVOLYUTSII DINAMICHESKOI SISTEMY]

S. V. Peletminskii and A. A. Yatsenko 1968 32 p refs In RUSSIAN; ENGLISH summary
(ITF-68-5)

On the basis of an asymptotic equation it is shown that at least in perturbation theory the stationary solution of the integral equations for the density matrix obtained in Part I is equivalent to the Gibbs distribution. It is brought to light the role of the free Hamiltonian and the principle of spatial relaxation of correlations for the initial state in the process of the system evolution. An integral equation is obtained for the density matrix applicable for $t >> \tau_0$ as well as for $t \leq \tau_0$. In an appendix an integral equation is obtained for the generating functional determining the collision integral and many-particle function of distribution. Author (NSA)

N68-32029*# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
THEORY OF NONEQUILIBRIUM PROCESSES IN STATISTICAL MECHANICS. 2: KINETIC EQUATIONS IN THE WEAK INTERACTION APPROXIMATION [K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. 2: KINETICHESKIE URAVNENIYA V PRIBLIZHENII SLABOGO VZAIMODEISTVIYA]
V. G. Bar'yakhtar, S. V. Peletminskii, and A. A. Yatsenko 1968 42 p refs In RUSSIAN; ENGLISH summary
(ITF-68-4)

In the base of results obtained in Part I the kinetic equations for the one-particle density matrix are considered. The kinetic equation for the non-diagonal one-particle density matrix is obtained in the Λ^1 approximation. When the distribution is uniform, the kinetic equations are obtained in the third and fourth approximation in interaction. Author (NSA)

N68-32033# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MATHEMATICAL MODELS FOR CALCULATION OF ELECTRICAL AND MAGNETIC FIELDS
O. V. Tozoni 25 Aug. 1967 309 p refs Transl. into ENGLISH of THE BOOK "Matematicheskiye Modeli dlya Rascheta Elektricheskikh i Magnitnykh Poley" Kiev, Izd. AN Ukr. SSR, 1964 p 1–304
(FTD-MT-66-86; AD-670961)

The monograph presents new methods of calculating electromagnetic fields using modeling and electronic computers, describes the operating principles and the design of models of the most complex mathematical operations, and examines the methods of calculating specialized modeling machines for calculating electromagnetic fields. The last chapter considers the theory of models of spatial static fields with an optimal boundary structure. Examples are included of the calculation and building of models with minimum distorting boundary and new methods of modeling. The book contains basically original material which can be used in the design of new types of electromagnetic equipment. The book is intended for researchers and engineers concerned with calculating electromagnetic fields and developing and designing new types of electrical and radio equipment. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-30864 Joint Inst. for Nuclear Research, Dubna (USSR).
REPORT OF THE INTERNATIONAL CONFERENCE ON PHYSICS OF HEAVY IONS. VOLUME 2: SYNTHESIS AND INVESTIGATION OF PROPERTIES OF ISOTOPES OF TRANSURANIC ELEMENTS [TRUDY MEZHDUNARODNOI KONFERENTSII PO FIZIKE TYAZHELYKH IONOV. VYPUSK 2: SINTEZ I ISSLEDOVANIE SCOISTV IZOTOPOV TRANSURANOVYKH ELEMEŃTOV]
[1967] 76 p refs In RUSSIAN and ENGLISH Conf. held in Dubna, USSR, 13–19 Oct. 1966
(JINR-D7-3548; CONF-661035)

CONTENTS:

1. SYNTHESIS AND INVESTIGATION OF PROPERTIES OF ISOTOPES OF TRANSURANIUM ELEMENTS G. N. Flerov, E. D. Donets, V. A. Druin, Yu. V. Lobanov, V. L. Mikheev et al p 3–18 refs (See N68-30865 19-24)

2. CHEMICAL PROPERTIES OF ELEMENT 104 I. Zvara, Yu. T. Chuburkov, R. Tsaletka, M. R. Shalayevskiy, T. S. Evsreva et al p 19–32 refs (See N68-39866 19-06)

3. SYNTHESIS OF HEAVY ELEMENTS BY MULTIPLE NEUTRON CAPTURE G. A. Cowan p 32–39 (See N68-30867 19-24)

4. CALCULATIONS ON THE PRODUCTION OF THE NEXT CLOSED SHELL NUCLEUS AND OTHER NUCLEI A. M. Friedman p 39–50 refs (See N68-30868 19-24)

5. CERTAIN EFFECTS OF TRANSURANIUM NUCLEAR SHELLS V. M. Strutinskii (Inst. At. Energii, Moscow) and Yu. A. Muzychko p 51–64 (See N68-30869 19-24)

6. THE INFLUENCE OF THE SUBSHELL WITH NEUTRON NUMBER N=152 ON THE MAGNITUDE OF γ_n/γ_f IN REACTIONS WITH HEAVY IONS V. L. Mikheev and S. M. Polikanov p 65–70 refs (See N68-30870 19-24)

N68-30865 Joint Inst. for Nuclear Research, Dubna (USSR).
SYNTHESIS AND INVESTIGATION OF PROPERTIES OF ISOTOPES OF TRANSURANIUM ELEMENTS [SINTEZ I ISSLEDOVANIE SVOISTV IZOTOPOV TRANSURANOVYKH ELEMENTOV]
G. N. Flerov, E. D. Donets, V. A. Druin, Yu. V. Lobanov, V. L. Mikheev et al *In its* Rept. of the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 3–18 refs In RUSSIAN (See N68-30864 19-24)

A brief review is given of the experimental research carried out at the Joint Institute for Nuclear Research during the period 1963 to 1966. The development of the cyclotron and other auxiliary detection equipment is discussed. Alpha-decay data on isotopes from einsteinium to lawrencium are tabulated. The controversy over the synthesis and identification of element 102 is also discussed. The synthesis and identification of element 104 is described, and it is indicated that the reactions $^{243}Am(^{22}Ne,4n)$ and $^{249}Am(^{22}Ne,5n)$ will be used in future attempts to synthesize element 105. NSA

N68-30867 Los Alamos Scientific Lab., N. Mex.
SYNTHESIS OF HEAVY ELEMENTS BY MULTIPLE NEUTRON CAPTURE
G. A. Cowan *In* Joint Inst. for Nucl. Res. Rept. of the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 32–39 Sponsored by AEC (See N68-30864 19-24)

Discussed are the practical upper limits in attainable mass for multiple neutron capture in explosions. Information is summarized which was gained in prompt multiple neutron capture experiments, and some features of possible future experiments are described. Specifically discussed are the results of a Los Alamos Cyclamen experiment in which a total of 10^{14} atoms of Fm 257 was obtained by exposing a U 238 target to a high neutron flux. K.W.

N68-30868 Argonne National Lab., Ill.
CALCULATIONS ON THE PRODUCTION OF THE NEXT CLOSED SHELL NUCLEUS AND OTHER NUCLEI

A. M. Friedman *In* Joint Inst. for Nucl. Res. Rept. on the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 39–50 refs Sponsored by AEC (See N68-30864 19-24)

Cross sections were calculated for nuclear reactions of the following type: $^{36}Ar + {}^{242}Cm \rightarrow {}^{278}Z + {}^{70}Ge + {}^{208}Pb$ + ^{278}Z. $^{84}Kr + {}^{194}Pt \rightarrow {}^{278}Z$ and $^{136}Xe + {}^{142}Nd \rightarrow {}^{278}Z$. These cross sections were calculated by using the usual expression for cross section σ_{cl} for forming a compound nucleus with a given angular momentum l of the incoming particles. However, for low excitation energies σ_{cl} involved below the fission threshold one can not assume that every angular momentum value will populate states with equal probability. Therefore, the cross sections σ_{cl} are multiplied by ρ_l, the density of states of spin l where l equals to 1 in the final nucleus, and Γ the average level width, since the targets and projectiles are all of spin = 0 and l = 1. The level densities at low excitation energies were also calculated for the nuclei ^{278}Z and ^{272}Z. The relation between ρ_l and σ_l and the product $\sigma_l\rho_l$ for ^{84}Kr and ^{194}Pt is illustrated; and the total cross sections for the formation of ^{272}Z and ^{278}Z with the different ions, using an average value of 0.1 eV for Γ, are presented. NSA

N68-30869 Joint Inst. for Nuclear Research, Dubna (USSR).
CERTAIN EFFECTS OF TRANSURANIUM NUCLEAR SHELLS [NEKOTORYE EFFEKTY OBOLOCHEK V TRANSURANOVYKH YADRAKH]
V. M. Strutinskii (Inst. At. Energii, Moscow) and Yu. A. Muzychko *In its* Rept. of the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 51–64 refs In RUSSIAN (See N68-30869 19-24)

The statistical or "drop" model for nuclear matter is discussed, and a comparatively simple method of microscopic calculation is suggested for shell corrections of the deformations in the model. Calculations were performed with a view of finding the minimum in large deformation. The existence of large regions of relative nuclear stability were predicted; however, predictions concerning the number of the element and its properties (fissibility, fission barrier, half-life) can not yet be predicted with the required accuracy. In spite of the universal concept that the influence of shell disappears with the nuclear γ deformation of the order of $A^{-1/3}$ ($\approx$0.2 to 0.3), it was found that with nuclear deformation appear significant characteristic condensations and rarefaction of the nuclear levels (shells) near Fermi energies which determine the equilibrate nuclear shape. In the spherical and deformed nuclei, a certain additional nuclear binding and stability energy are related to the shells. NSA

N68-30870 Joint Inst. for Nuclear Research, Dubna (USSR).
THE INFLUENCE OF THE SUBSHELL WITH NEUTRON NUMBER N = 152 ON THE MAGNITUDE OF Γ_n/Γ_f IN REACTIONS WITH HEAVY IONS [VLIYANIE PODOBOLOCHKI S CHISLOM NEITRONOV N = 152 NA VELICHINU Γ_n/Γ_f V REAKTSIYAKH S TYAZHELYMI IONAMI]
V. L. Mikheev and S. M. Polikanov *In its* Rept. of the Intern. Conf. on Phys. of Heavy Ions, Vol. 2 [1967] p 65–70 refs In RUSSIAN (See N68-30864 19-24)

The results are given of measurements of cross sections of formation of five isotopes of element 102 with N = 150 to 154 during irradiation of ^{242}Pu and ^{239}Pu targets by ^{18}O and ^{16}O ions from the cyclotron U-300. Concrete data are tabulated. All experiments were carried out on one installation, the relative accuracy of cross section magnitudes used in experiments on Γ_n/Γ_f was 20 to 30% which leads to the error Γ_n/Γ_f of about 5 to 7%. Experimental data concluded that the influence of the subshell with N = 152 extends up to 15 MeV excitation energy. The data include the sum of two-neutron bond energies, their kinetic energy and γ-quantum energy. NSA

N68-30876 Johns Hopkins Univ., Baltimore, Md.
A VARIATIONAL METHOD FOR WEAK RESONANT WAVE INTERACTIONS
William Frederick Simmons (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13831

A geometric construction characterizing admissible wave configurations is presented and applied to capillary-gravity waves, and internal gravity waves in a three-layered, stratified fluid. A similar construction is presented for third order resonant interactions among gravity waves. A calculational method which simplifies second order resonant interaction computations for waves whose amplitude and phase angle vary slowly with position and time is presented for systems which admit formulation in terms of a variational principle. The method is demonstrated for capillary-gravity waves, and internal gravity waves in a three-layered, stratified fluid. The results from the method are in simple form, and conservation laws for total mean wave energy and momentum are proved in both examples. A geometric representation of one-parameter wave modulations is presented together with an analytic representation, and a discussion of modulation period. Both periodic and non-periodic transfers, together with associated hydrodynamic instabilities are discussed and compared for space and time modulations. Dissert. Abstr.

N68-30888 Washington Univ., Seattle.
MEASUREMENT OF THE ABSOLUTE ELECTRON IMPACT IONIZATION CROSS SECTION OF THE METASTABLE He (2S 3) STATE OF HELIUM USING THE DOUBLE ELECTRON BEAM TECHNIQUE
Daniel Russel Long (Ph. D. Thesis) 1967 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-14188

The absolute electron impact ionization cross section of the metastable state of helium has been measured by the first successful application of the double electron beam technique. The cross section at the plateau is about 6.5×10^{-16} cm^2 $\pm$30%. This absolute ionization cross section measurement is in good agreement with the experimental results for lithium and with the theories for H(2s) when compensation for the differing ionization potentials is made. In the course of this work an unexpected very large signal was observed. We attribute this signal to surface assisted prethreshold photoionization, an evidently novel effect. Dissert. Abstr.

N68-30891 State Univ. of New York at Buffalo.
A STUDY OF HIGHER ORDER EFFECTS IN COULOMB EXCITATION
Henry Nebel (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13354

The second-order theory of Coulomb excitation is studied in detail in the semi-classical treatment, i.e., a classical orbit is assumed for the path of the projectile and the interaction due to the nuclear structure is treated quantum-mechanically using perturbation theory. Particular attention is paid to the reorientation effect which has been proposed as a means of measuring static quadrupole moments (Q_{22}) of first excited 2+ states in even-even nuclei. The reorientation effect involves excitation of the nucleus from its ground state to one magnetic sublevel of the final state followed by a transition between magnetic sublevels of that state due to the interaction of the projectile with the static moment of the final state. Measurement of this effect in even-even nuclei can provide a determination of the sign as well as the magnitude of Q_{22}. Dissert. Abstr.

N68-30910 Boston Univ., Mass.
MOESSBAUER STUDIES OF NUCLEAR QUADRUPOLE AND HYPERFINE INTERACTIONS
Subhas Chandra (Ph.D. Thesis) 1967 215 p
Available from Univ. Microfilms: HC $9.90/MF $3.00 Order No. 67-13285

This dissertation is concerned with a study by means of the Mössbauer effect of the nuclear quadrupole and magnetic hyperfine interactions in solids. The Mössbauer effect provides a suitable technique for measuring the microscopic effective magnetic field and electric field gradient (EFG) in para-, ferro-, antiferro-, and ferrimagnetic solids. The following research work has been done: 1. Theoretical calculations have been performed for finding the energy eigenvalues of the nuclear excited and ground states of Fe^{57}, their eigenvectors, the positions and the intensities of the Mössbauer lines for a number of choices of the various parameters. 2. Experimental studies have been made on a number of ferrous compounds which become "ordered" below certain low temperatures. The values of isomer shift and its temperature dependence, quadrupole splitting and its temperature dependence, the asymmetry parameter η, the magnitude of the effective magnetic field experienced by Fe^{57} nucleus and its relative direction with respect to the EFG principal axes have been determined. 3. An attempt has been made to explain these results on the basis of our Mössbauer results and on NMR, X-ray and neutron diffraction measurements. Dissert. Abstr.

N68-30936 Rutgers Univ., University Park, N. J.
PROTON SCATTERING FROM HEAVY ROTATIONAL AND VIBRATIONAL NUCLEI
Martin Barry Slagowitz (Ph.D. Thesis) 1967 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14761

Systematic data on heavy rotational and vibrational nuclei were obtained. The sensitivity of the angular distribution to nuclear deformation was studied. Differential cross sections were obtained for 16 MeV protons elastically and inelastically scattered from ^{165}Ho, $^{172, 174, 176}Yb$, $^{182, 180, 192}W$, $^{188, 190, 192}Os$ and Pt. The results are qualitatively compared to the predictions of coupled channel calculations. The comparisons are favorable and indicate that the transition to vibrational nuclei is not complete in ^{192}Os, but is complete in Pt. The inelastic angular distributions of protons scattered from rotational and vibrational nuclei differ more markedly than the elastic angular distributions. Dissert Abstr.

N68-30941 Montana State Univ., Missoula.
OPTICAL EMISSION PRODUCED BY PROTON AND HYDROGEN ATOM IMPACT ON NITROGEN AND HYDROGEN MOLECULES
Duane Arlen Dahlberg (Ph.D. Thesis) 1967 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-13579

Optical emissions produced in collisions of protons incident on nitrogen and hydrogen molecules and hydrogen atoms incident on the the same molecules were studied in the spectral region from 1200 Å to 6000 Å. Relative emission cross sections were measured in the energy range from 10 kev to 130 kev. The spectra excited by proton impact with nitrogen and hydrogen molecules were scanned with a monochromator and photomultiplier. The prominent features of the nitrogen spectrum below 2000 Å were the Lyman alpha line and some atomic nitrogen lines. Relative emission cross sections were measured for the production of a number of the First Negative bands, the (0,0) Second Positive band, an ionic nitrogen line, atomic nitrogen lines, and Lyman alpha in proton and hydrogen atom collisions with nitrogen gas. Relative emission cross sections for the production of the Lyman bands and Lyman alpha by proton and hydrogen atom impact on hydrogen molecules were also measured. Dissert. Abstr.

N68-30952 University of Southern Calif., Los Angeles.
A SELF-CONSISTENT FIELD FOR MOLECULAR HYDROGEN AND ITS APPLICATIONS
Roger Lawrence Wilkins (Ph.D. Thesis) 1967 196 p
Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-13047

Hartree-Fock single determinant wave functions are calculated numerically for both bound, and continuous states of molecular hydrogen. The oscillator strengths of dipole transitions from the ground state of molecular hydrogen are calculated using this complete set of single particle Hartree-Fock states. The resulting oscillator strengths are used to calculate the static parallel polarizability, static perpendicular polarizability, refractive index in the ultraviolet, the Rayleigh scattering cross section, the excitation energy of the molecular hydrogen which is required to calculate the average energy loss of hydrogen to fast particles, the van der Waal's constant for the long range interaction between two hydrogen molecules, and fifteen sum rules each for the parallel transition and the perpendicular transition. The cross sections for elastic scattering of low energy electrons by molecular hydrogen are calculated with and without the assumption of electron exchange. Dissert. Abstr.

N68-30965 Illinois Univ., Urbana.
ELASTIC SCATTERING IN VELOCITY-SELECTED MOLECULAR BEAMS AT THERMAL ENERGIES
Jon Byron Cross (Ph.D. Thesis) 1967 186 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-11838

A molecular beam apparatus is described which was designed to obtain total and differential scattering cross sections using a velocity selected beam and an universal mass spectrometer detector. The product of the Lennard–Jones parameters (ϵ-σ) was determined from total scattering measurements for the following systems: N_2-N_2, $\epsilon\cdot\sigma = 4.9\times10^{-22}$ erg-cm ±15%; D_2-Kr, $\epsilon\cdot\sigma = 4.1\times10^{-22}$ erg-cm ±10%; H_2-Kr, $\epsilon\cdot\sigma = 4.3\times10^{-22}$ erg-cm ±15%. Dissert. Abstr.

N68-30975 California Univ., Berkeley.
EQUIVALENT POTENTIAL METHOD FOR RELATIVISTIC SCATTERING
Jerome Lee Finkelstein 1967 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-11621

The equivalent-potential method is generalized so as to permit calculation both of multichannel scattering and of certain scattering amplitudes of particles of nonzero spin. As examples, the $\pi\pi$, πK, and πN amplitudes are considered. For the first two of these cases it is found that the force due to vector meson exchange is far too small, but that if the input couplings are increased so as to reproduce the vector mesons, then 2+ mesons are also produced, at roughly the masses of the f°(1250), f'°(1500), and K**(1405). In the πN case, with the potential given by nucleon and N*(1238) exchange, there are no free parameters in the calculation. The N* is then "predicted" at a mass of 1100 MeV. The nonresonant phase shifts also agree in a general way with the results of phase-shift analysis; in particular, the S_{11} scattering length has the correct sign, while N/D calculations produce the wrong sign. Dissert. Abstr.

N68-30976 California Univ., Berkeley.
TRANSIENT STUDIES OF ATOMIC HYPERFINE RELAXATION
Stephen Antonio Miller (Ph.D. Thesis) 1967 274 p
Available from Univ. Microfilms: HC $12.40/MF $3.55 Order No. 67-11650

The spin-exchange relaxation process has been studied in cesium vapor using a transient microwave resonance technique

which has permitted the first observations of coherent microwave emission from a vapor which has not been artificially polarized. Relaxation is observed as a decay of coherence between hyperfine levels induced by a pulse of microwave power. The observation of very weak microwave signals from the cesium hyperfine system has required extension of low-noise microwave reception and signal-averaging techniques. A formal theory of signal averaging has been developed with emphasis on applications to magnetic resonance. The results of this theory are applied to an analysis of the properties of the lock-in detector and the boxcar integrator. The problem of the relative sensitivities of CW absorption and transient free precession measurements is treated generally and the results have been confirmed experimentally in a test using both methods. Dissert. Abstr.

N68-30977 Illinois Univ., Urbana.
PROTON COMPTON EFFECT FOR 300 MeV PHOTONS
Edward Ray Gray (Ph.D. Thesis) 1967 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-11855

Cross section measurements of the elastic scattering of protons by protons have been taken at the maximum of the first pion-nucleon resonance. The bremsstrahlung beam was scattered from a liquid hydrogen target, and the scattered photons were converted and detected in a series of lead plates, spark chambers, and scintillation counters. Spark chambers in the proton telescope gave the direction of the proton recoil and the angle of deflection in the bending magnet. This deflection in the magnet was used to calculate the momentum of the proton, and with the direction of the recoil proton, the proton momentum was used to calculate the expected direction of an elastically scattered photon. At the 135° angle the two lower energy Compton cross sections measured were in agreement with previously measured values, and the high energy cross section measurement provided new data at the 135° angle essentially in agreement with theory. The 90° values were in agreement with previous measurements on the low energy side and with measurements on the high energy side at the middle of the first pion-nucleon resonance. Dissert. Abstr.

N68-30979 Cornell Univ., Ithaca, N. Y.
SEVENTY-FIVE KEV ELECTRON SCATTERING SPECTROSCOPY AND ELECTRON MICROSCOPY
James Doyle Edmonds, Jr. (Ph.D. Thesis) 1967 135 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-12343

An electrostatic unipotential lens has been developed for the electron microscope, operative at 75 keV. It can be used as an elastic scattering filter lens or as an energy loss analyzer, for measuring the energy loss spectrum, up to about 100 eV with a resolution of about 0.5 eV, of electrons inelastically scattered through less than 10^{-3} radians. Facilities were incorporated into the microscope for varying the beam energy over a range of 230 eV in 1.3 eV steps and the focal properties of the unipotential lens were studied as a function of electron energy. The plasmon excitation energy of aluminum was measured separately in the transmitted and diffracted beams for different orientations across a (111) bend contour. The excitation spectra of the beams were found to be identical within experimental error. Measurements were made on the scattering spectra of single crystals of nickel and silver for selected areas of (111) bend contours. Dissert. Abstr.

N68-30989# Iowa State Univ. of Science and Technology, Ames.
A STUDY OF THE REACTIONS $K^-P \rightarrow K^-P\pi^+\pi^-\pi^0$ AND $K^-P \rightarrow K^-N\pi^+\pi^+\pi^-$ AT 4.6 AND 5.0 GeV/c
Roland Edwin Juhala (Ph.D. Thesis) Feb. 1968 145 p refs
(Contract W-7405-ENG-82)
(IS-T-225) CFSTI: HC $3.00/MF $0.65

The final states $K^-p\pi^+\pi^-\pi^0$ and $K^-N\pi^+\pi^+\pi^-$ were studied in K−P interactions at 4.6 and 5.0 BeV/c. The data were prepared from 28000 pictures at each momentum taken in the 80" bubble chamber at Brookhaven National Laboratory. The cross sections for production of the final state $K^-p\pi^+\pi^-\pi^0$ are .76±.09 mb and .93±.12 mb, and for the final state $K^-N\pi^+\pi^+\pi^-$ .42±.06 mb and .39±.07 mb at 4.6 and 5.0 BeV/c, respectively. The effective mass distributions were studied by combining the data from both momenta. The effective cross sections for the combined data are .83±.12 mb for the $K^-P\pi^+\pi^-\pi^0$ final state and .41±.07 mb for the $K^-N\pi^+\pi^+\pi^-$ final state. The combined $K^-N\pi^+\pi^+\pi^-$ data consists of 701 events. The resonance production includes K^{*0} (890): 29±4%, Δ^-(1236): 17±3% and Δ^+(1236): 7.0±2.0%. There is, in addition, evidence for an enhancement at 960 MeV/c^2 in the $\pi^+\pi^+\pi^-$ mass spectrum of magnitude 6±2%. Author (NSA)

N68-30996 California Univ., Los Angeles.
THE MEASUREMENT OF NEUTRON WAVES
Rocco Anthony Fazzolare (Ph.D. Thesis) 1967 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-11710

A study of the experimental problems associated with the production, measurement, and interpretation of propagating neutron waves is presented. Particular attention is focused on waves of frequency greater than 100 cps, where present measurement techniques are inadequate. A new experimental method for the acquisition of data in the kilocycle range uses crosscorrelation to extract the wave from a high noise background. The pulse train emitted by a neutron detector is crosscorrelated directly with both a sine and a cosine signal without analog conversion. The two correlation outputs are vectorally added by an X2Y recorder. The result is a straight line, whose length and direction indicates the amplitude and phase of the fundamental wave component. A wave experiment using the correlation method was performed in a heterogeneous D_2O/natural uranium subcritical assembly. The results verify the validity and worthiness of the basic concept. Dissert. Abstr.

N68-30999 Yeshiva Univ., New York.
HIGHER SYMMETRY GROUPS AND ELEMENTARY PARTICLES
Ben Zion Tunkelang (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14588

The work is divided in three parts. In the first part we assign the elementary particles to the different representations of SU_3. We analyze the compatibility of the unitary octet mass formulae with the electromagnetic mixing. We derive new mass formulae for the 27 dimensional representation by expanding the matrix elements of vanishing multiple commutators. These formulae hold to second order in the medium strong and electromagnetic interaction and to the lowest cross-term (YQ^2) between them. In the second part, we assign the elementary particles to the representations of G_2; we define the intrinsic CA symmetry of this group and compare its consequences to the A symmetry. In the third part, we assign the elementary particles to the representations of B_3, a rank three group. We derive relationships among the three point vertex functions and finally we outline a weak current theory in B_3. Dissert. Abstr.

N68-31000 Pennsylvania Univ., Philadelphia.
MULTI-DIFFRACTION OF ELECTROMAGNETIC WAVES BY TWO SUCCESSIVE IMPEDANCE WEDGES
Kuo-Chun Lang (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-12769

It is the purpose of this dissertation to make an attempt to study the multi-diffraction by electromagnetic waves. The problem of two successive wedges of arbitrary angles with homogeneous impedance conditions is picked for this analysis. The approach is based on the general treatment of diffraction of plane wave by a single wedge with given surface impedances, and the concept of angular spectrum of plane-waves. The scattered field from the first wedge is decomposed into a continuous as well as a discrete spectrum of plane waves. This constitutes the incident wave on the second wedge. The multi-diffracted field can be formed up by superposing the solutions of all the component plane waves in the spectra. The field due to the discrete spectrum of the incident field is evaluated immediately whereas that due to the continuous spectrum of the incident field contains three integral expressions. The result of this analysis can be considered quite general.
Dissert. Abstr.

N68-31003 West Virginia Univ., Morgantown.
A SECOND QUANTIZATION APPROACH TO MULTIPLE SCATTERING
Charles Franklin Hayes, II (Ph.D. Thesis) 1967 80 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-11785

A second quantization approach is used in investigating scattering from a many-body system. Neglecting spin and exchange effects a variation technique is applied to a Hamiltonian to obtain two coupled equations which are the basis of our theory. Transforming to integral equations and imposing the unitarity condition results in a new form of the optical theorem. A transition matrix, therefore, is defined and is shown to indeed describe multiple scattering. Using an impulse approximation and an effective field approximation, relations for the Moller and transition operators were obtained. Due to possible energy shifts the wave functions were renormalized. The theory was used to derive an index of refraction equation which is similar to that derived by Lax and that by Watson. A method is given for using the theory to obtain the cross section.
Dissert. Abstr.

N68-31012 Delaware Univ., Newark.
LOW ENERGY SPUTTERING STUDIES
James Robert Joseph Woodyard (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-11748

Experimental and theoretical studies of low energy (0 to 100 eV) sputtering were conducted. A low-pressure magnetically confined arc discharge was used in a mass spectrometer ion source to study the sputtering of neutral Cu particles from a polycrystalline target by Ar+. Cu atoms were detected down to a bombarding Ar+ energy of 27 eV; Cu_2 molecules were detected down to 50 eV. The ejection patterns and sputtering yield resulting from Ar+ bombardment of Ag (100) near threshold were studied using an optical detection of deposits method. Sputtered particles were detected down to an ion energy of approximately 23 eV. No sputtered particles were detected at approximately 18 eV with a sensitivity of 3×10^{-5} atoms/ion. The ejection patterns showed that sputtering becomes even more preferential at ion energies near threshold. The bombarding particle energy transfer to the lattice was studied by using reasonable repulsive potential functions and considering important collision sequences. The role of the mass ratio of the bombarding particle and the target atom was investigated.
Dissert. Abstr.

N68-31021# Atomic Energy Centre, Dacca (Pakistan).
THE AKHIESER-POMERANCHUK-BLAIR MODEL ANALYSIS FOR ELASTIC SCATTERING OF DEUTERONS
M. Rahman, A. H. Khan, and H. M. Sen Gupta (Dacca Univ.) Nov. 1967 10 p refs
(AECD/TP-23)

Angular distributions of deuterons elastically scattered from Mg, Fe, Cu, and Zn were analyzed in terms of the smoothed Akhieser–Pomeranchuk–Blair model; reasonable agreement was obtained in each case up to about 90°. The interaction radius R and the surface thickness ΔR were obtained from the best-fit parameter-values.
Author (NSA)

N68-31025# Toulouse Univ. (France).
HIGH ENERGY NUCLEOSYNTHESIS
H. Reeves 1966 86 p refs Presented at the Summer School on Space Phys., Tarbes, France, 19 Aug.–23 Sep. 1966 Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Low energy nucleosynthesis is reviewed, with concentration on those parts of nucleosynthesis which are well explained by nuclear physics theories. Historical sequence of events from the origin of the universe are analyzed in view to recognize characteristic nucleosynthetic events. Three aspects are discussed in detail: stellar cosmic rays, galactic cosmic rays and meteorites. ESRO

N68-31027 California Univ., Santa Barbara.
QUANTUM MECHANICAL CALCULATIONS OF REACTION PROBABILITIES OF THREE BODY EXCHANGE REACTIONS
Izhack Oref (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-11006

Quantum mechanical calculations were performed on the reaction probabilities of linearly constrained systems. The transmission coefficients of the reaction AB + C → A + BC, where AB is a diatomic molecule and C is an atom, were calculated for a variety of initial conditions and potential surfaces. Calculations of the vibrational energies of the complex ABC revealed that only a small portion of the vibrational energy of the reactant diatomic molecule is available for crossing the barrier. The wavefunctions and the probability density functions, $|R|^2 r$, of the complex indicated that at low total energy the reaction path is confined to large interatomic distances within the complex. At high energies the reverse is true and the reaction path is confined mainly to small interatomic distances within the complex. The rate constant of the reaction H + D_2 → HD + D was calculated for a variety of potential surfaces and compared with the experimental results which were obtained by LeRoy and Schulz. The method used in the calculations of the transmission coefficients provides new insight into the nature of the reaction complex, and the energy distribution in it.
Dissert. Abstr.

N68-31038 George Washington Univ., Washington, D. C.
NONLOCALITY IN QUANTUM ELECTRODYNAMICS
William Carleton Parke (Ph.D. Thesis) 1967 90 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-14409

The present investigation attempts to clarify the concept of nonlocality as a generalization of the usual assumptions in field theory and, in a different sense, through its manifestation in conventional quantum field theory. A characterization of a nonlocal theory can be made using the Dirac-Schwinger energy density commutation relations, which we derive using only relativistic covariance of the energy-momentum density tensor. We investigate nonlocal theory first suggested by Pais and Uhlenbeck. Although the infinities associated with the vacuum energy and the infrared divergence are still present, the self-energy and vacuum polarization are finite in this theory. Thus one feels that the theory proposed is at best intermediate between our present theory and a more encompassing one. In any case, there is no direct experimental evidence for the breakdown of the local field concept or of quantum electrodynamics. A different kind of nonlocality appears within the framework of a local quantum field theory. This arises in a relativistic description of the particle nature of the quantum field. We discuss

the desired requirements of the operators associated with the particle aspect of the field and some of their properties. Dissert. Abstr.

N68-31048 Rice Univ., Houston, Tex.
FINAL STATE INTERACTIONS IN THE H 2(p,pn)p REACTION
William Roy Jackson, Jr. (Ph.D. Thesis) 1967 155 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-13087

The $^{2}H(p,pn)p$ reaction has been studied, at a bombarding energy of 9.0 Mev and several coincidence detection angles using the Rice University Tandem Van de Graaff Accelerator and computer-analyzer system. The energies of the detected coincident particles were determined using a solid state surface barrier detector for the proton and time-of-flight measurement on the neutron. The data are discussed with regard to the observed final state interactions and the generalized density of states. Evidence is seen for a neutron-proton final state interaction corresponding to an interaction energy from slightly more than zero to about 75 kev; however, no evidence is found for a proton-proton final state interaction. Dissert. Abstr.

N68-31061 California Univ., Los Angeles.
BETA AND GAMMA RAY STUDIES OF SHORT LIVED ISOTOPES IN THE 2S-1D SHELL
Anthony John Armini (Ph.D. Thesis) 1967 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-12224

The short lived beta and gamma spectra of Na^{20}, Al^{24}, P^{28}, Cl^{32}, and Sc^{40} were measured with a single wedge gap magnetic spectrometer and a lithium drifted germanium detector. These isotopes were produced by proton induced reactions on the even-even $T_z = 0$ nuclei in the 2s-1d shell. Background and contaminants were separated from these short lived isotopes at each positron momentum by an on-line computer. The complete decay schemes are presented, including the ground-state masses and the first T=1 analogue states in the daughter nuclei. These isotopes lie in an interesting transition region between the deformed (Na^{20} and Al^{24}) and the spherical nuclei (Ca^{40}). Dissert. Abstr.

N68-31065 Pennsylvania Univ., Philadelphia.
THE NUCLEAR STRUCTURE OF N^{16} AND THE N^{14} (T,P) N^{15} (D,P) N^{16} AND O^{18} (D,α) N^{16} REACTIONS
Peter Vladimir Hewka (Ph.D. Thesis) 1967 111 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-12751

A high-resolution study of the ^{16}N nucleus was carried out, and a thin-window rotating gas target was developed and tested. The $^{40}Ar(d,p)^{41}Ar$ and $^{36}Ar(d,p)^{37}Ar$ reactions were studied, partly as a final test of the gas target. In the ^{41}Ar nucleus, 122 energy levels were observed below 8.3 Mev excitation, and 73 excited states of ^{37}Ar were observed below 9.1 Mev. Three separate reactions, $^{14}N(t,p)^{16}N$, $^{15}N(d,p)^{16}N$ and $^{18}O(d,\alpha)^{16}N$, were employed in the ^{16}N study. A total of 35 excited states was observed (plus 3 tentative levels) below 8.4 Mev excitation in ^{16}N. Level widths and angular distributions were measured for every level observed in the (t,p) reaction, and, whenever possible, in the (d,p) reaction. Several new spin and parity assignments were made, based on the (t,p) angular distributions. In particular, the theoretically predicted 1^-1 and 2^- states arising from the $(1p_{1/2})^{-1}\ 1d_{3/2}$ configuration have been identified at 4.720 and 5.308 Mev excitation. Dissert. Abstr.

N68-31081 California Univ., Davis.
DIRECTIONAL CORRELATION MEASUREMENTS IN Bi^{211}
George Arthur Carlson (Ph.D. Thesis) 1967 145 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14967

Directional correlation measurements of the 427-405 keV and 702-405 keV gamma-ray cascades in Bi^{211} have been made. The measured spins were found to be 9/2 for the 832 keV state and 9/2 for the 1104 keV state. The transitions are M1 with an E2 mixing of 42%±3%, 17%±3%, and 8%±11% for the 405, 427 and 702 keV transitions respectively. In addition, the internal conversion coefficients of the 351 (Tl^{207}) and 405 keV lines in the spectrum were measured to be 0.167±0.015 and 0.0796±0.006 respectively. Dissert. Abstr.

N68-31082 California Inst. of Tech., Pasadena.
CALCULATION OF THE N* /1238/ ELECTROMAGNETIC MASS DIFFERENCES BY S-MATRIX METHODS
Frank Stephen Henyey (Ph.D. Thesis) 1967 48 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-14350

The electromagnetic mass differences within the N*(1238) isomultiplet is calculated, using the S-matrix theory of perturbations developed by Dashen and Frautschi. An ambiguity in the choice of methods for calculating the effect of one photon exchange, and lack of sufficient data on the rho meson lead to rather large uncertainties in the predicted mass differences. Results are consistent with experimental determinations of the differences, which also have rather large uncertainties. Dissert. Abstr.

N68-31083 California Univ., Los Angeles.
COMPTON SCATTERING FROM TR PROTONS AT 90° IN THE ENERGY RANGE 550–1130 MEV
Bernard Kenton (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-14310

The differential cross-sections for the Compton scattering process, $\gamma + p \rightarrow \gamma' + p'$, have been measured at the center-of-mass angle of 90° for incident photon energies from 550 to 1130 Mev. The electron synchrotron at the California Institute of Technology provided the necessary Bremsstrahlung beam for this experiment. Both final state particles were detected. The time-of-flight and the laboratory angle of the recoil proton were used to determine the incident photon energy. The measured cross-sections were consistent with, although somewhat greater than, the cross-sections measured in previous experiments. Dissert. Abstr.

N68-31092# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
DYNAMICAL APPARATUS OF AXIOMATIC APPROACH IN QUANTUM ELECTRODYNAMICS [DINAMICHESKII APPARAT AKSIOMATICHESKOGO METODA DLYA KVANTOVOI ELEKTRODINAMIKI]
V. P. Pavlov and A. D. Sukhanov 1967 30 p refs In RUSSIAN; ENGLISH summary Presented at the conf. on Axiomatic Quantum Field Theory and Elementary Particles, Kiev, May 1967
(ITF-67-30; UDK-538.3; CONF-670544-10)

The dynamical equations of Bogoliubov's axiomatics are solved effectively for spinor electrodynamics by the method developed by Medvedev, Polivanov, Sukhanov. Heisenberg currents and current-like operators $\Delta^{(n)}$ are obtained, in terms of which are expressed some products of Heisenberg operators including equal-time commutators of Heisenberg Currents and fields. The proper commutator of the components of electromagnetic current is equal to zero while the commutator of spinor and electromagnetic currents involves a term of the Schwinger type. Author (NSA)

N68-31097# Paris Univ., Orsay (France). Lab. de Physique Theorique et Hautes Energies.
NOTE ON X-RAY SCATTERING BY ARGON

Dominique Levesque and Loup Verlet Mar. 1968 6 p refs
(LPTHE-TH-68/9)

The structure factor measured by x-ray scattering experiments on argon is compared with the same quantities calculated with two different intermolecular potentials. It is shown that it is not possible to get, from the scattering data, quantitative information concerning the interaction and that the discrepancy between theory and experiment is probably due to a systematic error in the latter. Author (NSA)

N68-31100# Argonne National Lab., Ill.
γ-RAY SPECTRUM FROM THE RADIATIVE CAPTURE IN CS [GAMMA-SPEKTR IZ RADIATSIONNOGO ZAKHVATE NA CS]
F. Bechvarzh, Ya. Vrsal, Ya. Liptak, and Ya. Urbanec Apr. 1968 10 p refs Transl. into English of the JINR-P3-3697 Rept., 1968
(ANL-TRANS-604) CFSTI: HC $3.00/MF $0.65

Measurements of the γ-ray spectra following resonance neutron capture in ^{133}Cs, performed with the aid of the Ge(Li) detector of active volume about 12 cm^3, are described. The energies and intensities of a number of transitions were obtained. Author (NSA)

N68-31112# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
INTERACTION WITH DERIVATIVES MODEL ADMITTING AN EXACT SOLUTION [MODEL VZAIMODEISTVIYA S PROIZVODNYMI DOPUSKAYUSHCHAYA TOCHNOE RESHENIE]
B. V. Medvedev and M. K. Polivanov 1967 29 p refs In RUSSIAN; ENGLISH Summary Presented at the conf. on Axiomatic Quantum Field Theory and Elementary Particles, Kiev, May 1967
(ITF-67-25; UDK-519.4; CONF-670544-9)

The quadratic in fields–interaction with derivatives model which is responsible for the renormalization of field operators is considered. Explicit expressions for the Heisenberg field and current operators are obtained. The formalism being repeated, the renormalization constants are replaced by integral operators of a special kind. In addition, the renormalization of the terms off and on the energy shell is different. The account of this allows one to overcome some difficulties when the condition of integrability for currents is renormalized in Bogolyubov's axiomatics. Author (NSA)

N68-31119# Princeton Univ., N. J.
MEASUREMENT OF THE KAON YIELDS TWO GAMMA BRANCHING RATIO
Paul F. Kunz (Ph.D. Thesis) 31 May 1968 87 p refs
(Contract N00014-67-A-0151-0001)
(TR-46; AD-671198)

A measurement of the branching ratio (neutral-K(L) to gamma gamma)/(neutral-K(L) to 3 pions) was made with a spark chamber gamma ray spectrometer and it is compared with theoretical predictions. From this measurement and from the published branching ratio of (neutral-K(L) to 3 pions)/(neutral-K(L) to all), the branching ratio of (neutral-K(L) to gamma gamma)/(neutral-K(L) to all) was found to be (5.5 plus or minus 1.1) x 0.0001. Author (TAB)

N68-31131# Northwestern Univ., Evanston, Ill.
TRANSMISSION OF 1-25 keV IONS THROUGH CRYSTAL FOILS
R. L. Hines and C. J. Andreen (Chalmers Univ. of Technol.) [1967] 18 p refs Presented at Conf. on Atomic Collisions and Penetration Studies with Energetic (keV) Ion Beams, Chalk River, Ontario
(Contract AT(11-1)-1053)
(COO-1053-9; CONF-670966-1) CFSTI: HC $3.00/MF $0.65

The penetration of low-energy ions in crystals can be measured in a direct way by using metal target foils made by vacuum evaporation. Good crystals of gold and iron have been prepared with thicknesses between 200 and 1000 Å. The foils are mounted on electron-microscope grids held in a goniometer that tilts the film normal and rotates the film about its normal. The transmitted ion current is measured with an electrometer in the forward direction as a function of foil orientation. Strong channel peaks are observed in transmission and energy loss for H+, D+, and He+ ions in gold and iron. A detailed study of the critical angles for H+, D+, and He+ ions in gold agrees with Lindhard's theoretical predictions. Author (NSA)

N68-31135 University of Southern Calif., Los Angeles.
MEASUREMENTS OF THE ENERGY DEPENDENCE OF THE PROTON TOTAL REACTION CROSS SECTIONS OF CARBON AND OPTICAL MODEL ANALYSES OF PROTON-CARBON ELASTIC SCATTERING
Motoji Quincy Makino (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13755

Measurements of the proton total reaction cross sections of carbon using the attenuation technique for proton energies between 16 MeV and 28 MeV are described, the measured cross sections are given, and the results of optical model analyses of all available data on proton elastic scattering from carbon in this energy range are presented. The results of the optical model analyses indicate that a small value of the real radius parameter (1.00 fermi) is necessary to fit the polarization measurements, and a larger value (1.25 fermi) is required for the imaginary radius parameter. The predicted total reaction cross sections above 20 MeV are in excellent agreement with the experimental results. However, below 20 MeV it is found that the predicted reaction cross sections are lower than the experimental cross sections. Dissert. Abstr.

N68-31141 Boston Univ., Mass.
ON HIGHER SYMMETRIES AND MASS SPECTRUM OF ELEMENTARY PARTICLES
Chor Jin Koh (Ph.D. Thesis) 1967 69 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-13282

It was suggested by some physicists some years ago that the mass-splitting of a multiplet of elementary particles may arise from the existence of certain higher symmetry, possibly a non-trivial combination of the internal and the external symmetries. In this dissertation the possibility of obtaining a mass spectrum on such grounds is examined, using group theoretical methods. Dissert. Abstr.

N68-31142 California Inst. of Tech., Pasadena.
ISOTOPE SHIFT MEASUREMENTS USING K X-RAYS IN Sn, Sm, and W
Ronald Benjamin Chesler (Ph.D. Thesis) 1967 113 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-14344

Electronic Kα1 X-ray isotope shifts were measured for Sn 116–124, Sm 148–154, W182–184, W184–186, and W182–188 using a curved crystal Cauchois spectrometer. The analysis of the measurements included the electrostatic volume effect, screening by the transition electron as well as the non-transition electrons, normal and specific mass shifts, dynamical nuclear quadrupole polarization, and a radiative correction effect of the electron magnetic moment in the nuclear electric field. Results for the isotopic changes in the nuclear charge radii are obtained. Where other experimental data are available, the agreement with the present

measurements is satisfactory. Comparisons with several nuclear model predictions yield only partial agreement. Dissert. Abstr.

N68-31151 Harvard Univ., Cambridge, Mass.
PRODUCT EXCITATION IN REACTIVE SCATTERING OF MOLECULAR BEAMS
John Horton Birely (Ph.D. Thesis) 1967 183 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-11688

Angular distributions of elastically scattered alkali atoms (M) and reactively scattered alkali halides (MX) were measured in collisions of crossed thermal beams of K, Rb, and Cs with Br_2 and I_2. Reaction cross sections are quite large ($\gtrsim$200 Å^2); most of the heat of reaction appears as internal product excitation rather than relative translational energy (E'); and, in the center-of-mass system, MX recoils predominantly forward with respect to the M beam. The properties of the system $Rb+SCl_2$ are shown to be similar to those of the diatomic halogen reactions. Velocity distributions of K and KBr for the $K+Br_2$ reaction measured using a mechanical velocity selector confirm that the energy released in this system is absorbed mainly by internal product degrees of freedom. Distributions in angle and energy of the products of three body exchange reactions $A+BC \rightarrow AB+C$ are calculated in the limiting case where A interacts only with part B of the target molecule and the products separate before momentum can be transferred to C. Dissert. Abstr.

N68-31152 California Inst. of Tech., Pasadena.
NUCLEAR HYPERFINE INTERACTIONS IN W^{182}, W^{183}, AND Pt^{195} AS STUDIED BY THE MOSSBAUER EFFECT
David George Agresti (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-14358

The Mössbauer technique was used to study the nuclear hyperfine interactions and lifetimes in W^{182} (2+ state) and W^{183} (3/2− and 5/2− states). Results are discussed in terms of a rotation-particle interaction in W^{183} due to Coriolis coupling. From the measured quantities and additional information on γ-ray transition intensities magnetic single-particle matrix elements are derived. It is inferred from these that the two effective g-factors, resulting from the Nilsson-model calculation of the single-particle matrix elements for the spin operators, are not equal. The internal magnetic fields at the tungsten nucleus were determined for substitutional solid solutions of tungsten in iron, cobalt, and nickel. The 5/2− state of Pt^{195} was studied with the Mössbauer technique, and the g-factor of this state was determined to be -0.41 ± 0.03. The following magnetic fields at the Pt nucleus were found: in an Fe lattice, 1.19 ± 0.04 MG; in a Co lattice, 0.86 ± 0.03 MG; and in a Ni lattice, 0.36 ± 0.04 MG. Isomeric shifts detected in a number of compounds and alloys were interpreted to imply that the mean square radius of the Pt^{195} nucleus in the first-excited state is smaller than in the ground state. Dissert. Abstr.

N68-31154 Columbia Univ., New York.
A SELF-CONSISTENT FIELD STUDY OF $KNiF^3$
Burton Sidney Kleinman (Ph.D. Thesis) 1967 165 p
Available from Univ. Microfilms; HC $7.60/MF $3.00 Order No. 67-14062

A Hartree-Fock molecular orbital self consistent field calculation has been carried out for the $Ni^{2+}F_6^{-}$ cluster. A core potential was used to represent the metal inner shell electrons (1S through 3P). Four independent radial functions were employed for the nickel 3D electrons and two radial functions for the fluorine 1S and 2S electrons and one for the fluorine 2P electrons. All integrals over one and two atomic centers and, in addition, all one-electron integrals over three atomic centers were accurately evaluated. The inclusion of these three center integrals is shown to be important. Multi-center two-electron integrals are also indicated to be essential. A closed shell SCF program was used with orbital occupation numbers adjusted to approximate the open shell. The results indicate significant ligand (2S–2Pσ) mixing and 3D presence in bonding orbitals. The calculated spin densities are smaller than experimental values; $10D_q$ is larger. Comparisons with and analysis of other calculations indicates points of inadequate treatment. Dissert. Abstr.

N68-31156# Gulf General Atomic, San Diego, Calif.
FAST NEUTRON SPECTRA IN MULTIPLYING AND NON MULTIPLYING MEDIA
J. M. Neill, J. L. Russell, Jr., R. A. Moore, and C. A. Preskitt 23 Feb. 1968 17 p refs Presented at the 2d Joint APS-ANS Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 1968
(Contract AT(04-3)-167)
(GA-8551; CONF-680307-33) CFSTI: HC $3.00/MF $0.65

Fast neutron spectra were measured at various positions in spheres of depleted uranium and 93.2% enriched uranium, and these data were used to provide integral checks on the accuracy of neutron cross sections and computational methods. The data cover the energy range between about 10 keV and 15 MeV and were obtained using three flight path lengths, 45, 50, and 210 meters. The detectors used consisted of a 5-in. diameter NE-213 proton-recoil detector for fast neutrons and a 5-in. diameter NE-908 lithium glass detector for intermediate energy neutrons. The pulsed source for the measurements was obtained by impinging the beam from the Gulf General Atomic Linear Electron Accelerator onto tungsten or uranium targets. The measured spectra in the ^{238}U spheres are consistently softer than the calculated values. The measured spectra in the ^{238}U sphere are accurate enough to permit one to choose the better of the two cross section sets. Author (NSA)

N68-31157# Gulf General Atomic, San Diego, Calif.
NEUTRON CROSS-SECTION MEASUREMENTS Summary Report, 1 Mar. 1967–29 Feb. 1968
M. P. Fricke and W. M. Lopez 26 Mar. 1968 47 p refs
(Contract AT(04-3)-167)
(GA-8602) CFSTI: HC $3.00/MF $0.65

An investigation of the capture cross section of Gd was initiated; preliminary resonance parameters are presented for ^{155}Gd and ^{157}Gd. Developments in methods for analyzing time-of-flight data are also reported, together with improvements in experimental facilities for time-of-flight measurements at the linear accelerators. A CDC-1700 computer was installed at the linear accelerator facility as part of an on-line acquisition system. NSA

N68-31159# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
SPACE-CHARGE SPREADING OF AN ION BEAM IN A UNIFORM ACCELERATING FIELD
J. H. Terhune and C. A. Pirolo, ed. 22 Apr. 1968 27 p
(Contract AT(29-2)-656)
(GEPP-28; R68ND5) CFSTI: HC $3.00/MF $0.65

A simplified model is developed to describe the space-charge spreading of an ion beam in a uniform accelerating gap. The model is a one-dimensional, steady-state, constant-current approximation to rigorous equations for ionic motion under the influence of space-charge and externally applied fields. Numerical results that describe the variation of ion beam radius with several parameters of the ion-optics system are presented. The analytical expressions deduced in this report are valid over limited ranges of the parameters, and are useful in engineering design of ion-optics systems. Author (NSA)

N68-31170 Florida State Univ., Tallahassee.
NUCLEAR STRUCTURE OF DY^{161}, DY^{159}, AND DY^{157}
Michael Johnson Bennett (Ph.D. Thesis) 1967 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-14441

This dissertation describes a series of (d,p) and (d,t) reaction studies leading to the nuclei ^{161}Dy, ^{159}Dy, and ^{157}Dy. Each nucleus, studied by both reactions at several angles, lies in the region of transition between barely deformed and fully deformed. The experiment was designed to test the applicability of the Nilsson model in this transitional region and, in conjunction with previously published studies on the heavier Dy nuclei, to trace the systematics of the Nilsson levels throughout the Dy nuclei. A total of 20 levels have been observed up to an excitation energy of 880 keV in ^{161}Dy. The following Nilsson bands have either been confirmed or newly assigned: 5/2+[642], 5/2−[523], 1/2−[521], 3/2−[521], and 5/2−[512]. In ^{159}Dy a total of 32 levels have been observed up to an excitation energy of 1.650 MeV and assignments have been made or confirmed to the Nilsson orbitals with asymptotic quantum numbers 3/2−[521], 5/2+[642], 5/2−[523], 1/2−[521], and 11/2−[505]. The ^{157}Dy nucleus has been studied with a total of 27 levels observed up to an excitation energy of 1.243 MeV. Band assignments have been made for the 3/2−[521], the 5/2−[523], and the 1/2−[521] Nilsson bands. Ground state Q values were measured. Dissert. Abstr.

N68-31181# Gosudarstvennyi Komitet po Ispolzovaiyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
QUASI-CLASSIC APPROXIMATION FOR ALTERNATING FIELDS [KVAZIKLASSICHESKOE PRIBLIZHENIE DLYA PEREMENNYKH POLEI]
V. S. Popov, V. P. Kuznetsov, and A. M. Perelomov 1967 67 p refs In RUSSIAN; ENGLISH summary
(ITEF-517)

The approximation for the barrier penetrability is generalized for the case of time-dependent potentials. The penetrability calculation is reduced to the evaluating of sub-barrier trajectory formally satisfying classical mechanics equations and complex initial condition (the time t for the sub-barrier motion is imaginary). It is shown that the use of general formulae obtained for atom ionization in the strong light-wave-field allows one to simplify the calculations considerably. One formula was obtained for the probability of ionization of the bound state with the angular momentum 1 by the wave with arbitrary elliptic polarization. The particle motion was studied in the high-frequency field ($\gamma = \omega/\omega_t >> 1$, where ω is the oscillation frequency of the barrier, and ω_t is the tunneling frequency through an immovable barrier). Unlike the case of a constant field, the tunneling probability at $\gamma >> 1$ is mainly defined by a small vicinity of the turning point. In this case, the frequency ω increasing, the effective width of the barrier decreases, resulting in the increase of penetrability. Author (NSA)

N68-31186# New York Univ., N. Y. Dept. of Physics.
ANGULAR DISTRIBUTION OF THE OUTGOING ELECTRONS IN ELECTRONIC IONIZATION
A. E. Glassgold Jun. 1968 42 p refs
(Contract Nonr-285(58))
(TR-N68-2; AD-671071)

The information which can be obtained from measurements on both the outgoing particles in single ionization is discussed for the case of high-energy electrons incident on neutral one-and two-electron atoms. The Born Approximation is used to analyze a particular experiment suggested by studies of the nuclear (p,2p) reaction. It is concluded that the momentum distribution for the single-electron orbitals of atomic systems can be determined by experiments of this type. The effects of identity and correlations are investigated, especially for the case of target helium atoms. Author (TAB)

N68-31187# Argonne National Lab., Ill.
γ-RAY SPECTRA FROM THE RESONANCE NEUTRON CAPTURE IN BA AND PR [SPEKTRY GAMMA-LUCHEI IZ ZAKHAVATA REZONANSNYKH NEITRONOV NA IZOTOPAKH BA I PR]
F. Bechvarzh, Ya. Vrzal, Ya. Liptak, and Ys. Urbanec Apr. 1968 22 p refs Transl. into ENGLISH of the JINR-P3-3696 Rept., 1968
(ANL-TRANS-605) CFSTI: HC $3.00/MF $0.65

With the help of a high-resolution spectrometer the γ-ray spectra following neutron capture in ^{135}Ba and ^{141}Pr were measured. On the basis of the results obtained, conclusions have been drawn about the character of intensive primary transitions for the 24.5-eV resonance of ^{135}Ba and about the character of the resonances in ^{141}Pr as well. Author (NSA)

N68-31206# Atomic Energy Centre, Dacca (Pakistan).
K-MESON NUCLEON FORWARD DISPERSION RELATIONS AND THE EVALUATION OF THE COUPLING CONSTANTS
Gulshan Ara and A. M. Harun-Ar Rashid Oct. 1967 16 p refs
(AECD/TP-22)

The forward scattering dispersion relations for K-meson nucleon system are evaluated with a view to determining the coupling sonstants. Two different forms of dispersion relations as proposed by Igi are particularly convenient for this purpose. Using the most recent data on total cross sections and the zero-range scattering lengths in the evaluation of the unphysical continuum, reasonable values of the coupling constants are obtained. Author (NSA)

N68-31207# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE REACTIONS (d, p) AND (d, t) LEADING TO THE SPONTANEOUSLY FISSIONABLE ISOMERS [ISSLEDOVANIE REAKTSII (d, p) I (d, t) PRIVODYASHCHIKH K SPONTANNO DELYASHCHIMSYA IZOMERAM]
S. Bjoernholm, J. Borggreen, Yu. P. Gangrskii, and G. Slattan 1968 10 p refs In RUSSIAN Submitted for publication
(JINR-P6-3744)

The reactions (d, p) and (d, t), leading to the spontaneously fissionable ^{240}Am, ^{242}Am, and ^{244}Am isomers were investigated in the energy range of 9 to 13 MeV. The measurement of the (d, p) and (d, t) reactions cross sections has shown that the isomeric ratio in these reactions is rather small as compared to that of the reactions (d, 2n), which lead to the production of the same nuclei. The difference in isomeric ratios can not be explained by the difference in distributions according to the excitation energies and the spin of the Am nuclei remaining after the particle emission. Author (NSA)

N68-31208# Paris Univ., Orsay (France). Inst. of Nuclear Physics.
POTENTIAL SCATTERING BY A NUCLEAR HARTREE-FOCH FIELD
D. Vautherin and M. Veneroni Feb. 1968 13 p refs
(IPNO/TH-118)

The Hartree-Fock spectra of ^{16}O and ^{40}Ca nuclei are calculated in coordinate space. In lowest order, the continuum states correspond to neutron elastic scattering. Phase shifts are given, and single-particle resonances are discussed. Author (NSA)

N68-31209# Polish Academy of Sciences., Warsaw. Inst. of Nuclear Research.
ANGULAR CORRELATIONS BETWEEN PIONS IN TEN-PRONG POSITIVE PION PROTON INTERACTIONS AT 8 GeV/c PRIMARY POSITIVE PION MOMENTUM

Andrzej Eskreys and Halina Wolak 1967 10 p refs
(INR-876/VI/PH)

The strong angular correlations between pions were found in 10-prong $\pi^+ - p$ interactions at 8 GeV/c. The average opening angle of pion pair of like charges is smaller than that for pairs of unlike pions. This effect appears to be stronger in 10-prong interactions than in 8-prong interactions and much stronger than in 6-prong interactions at the same incoming momentum.
Author (NSA)

N68-31210# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
MASS FORMULA IN BROKEN SL(2,C) AND ITS APPLICATION TO THE NUCLEON AND DELTA REGGE TRAJECTORIES
G. Domokos, S. Koevesi-Domokos, and P. Suranyi 10 Apr. 1968 9 p refs
(KFKI-5/1968)

Consequences of a Regge-trajectory generating algebra SL/2,C/ are explored at nonvanishing energy. Nucleon and delta trajectories satisfy a second-order mass formula remarkably well.
Author (NSA)

N68-31211 Illinois Univ., Urbana.
CALCULATIONS ON PRODUCTION REACTIONS USING THE ABSORPTIVE PERIPHERAL MODEL
John Thomas Donohue (Ph.D. Thesis) 1967 214 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-11845

We present calculations for the production and decay angular distributions of resonances produced in high energy collisions. The peripheral model with absorption is used in the calculations; only two body meson induced reactions are treated. A comparison between the partial wave summation method, which is used here, and the earlier impact parameter formalism is given. The reaction $K^- p \rightarrow K^0 N$ is treated in detail, as both pseudoscalar and vector meson exchanges appear to be important. The possibility of determining the signs of coupling constants from a study of these reactions is discussed. Reactions in which two resonances are produced are analyzed for correlations between the decay angles of the resonances, and absorption model predictions for these correlations are compared with experiment. The problem of measuring the branching ratio for the decay $\rho^0 \rightarrow e^+e^-$ is discussed, first generally, and then using absorption model predictions to estimate the effect of the $\omega \rightarrow e^+e^-$ decay mode. The exchange of baryons is treated in an attempt to understand the small backward peaks in differential cross sections for some reactions. Absorption model predictions are found to be unreliable for these reactions.
Dissert. Abstr.

N68-31226# Toulouse Univ. (France).
INTRODUCTION TO THE SPECTROSCOPY: MOLECULAR SPECTRA. BOOK II [NOTIONS DE SPECTROSCOPIE: SPECTRES MOLECULAIRES. LIVRE II]
H. Boiteux 1966 46 p In FRENCH Presented at the Summer School on Space Phys., Tarbes, France, 19 Aug.–23 Sep. 1966 Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

A description is given of spectral bands. Explanation of the formation of the bands is given. Brightness and transition probability are analyzed.
ESRO

N68-31229# Toulouse Univ. (France).
INTRODUCTION TO THE SPECTROSCOPY: ATOMIC SPECTRA. BOOK I [NOTIONS DE SPECTROSCOPIE: SPECTRES ATOMIQUES. LIVRE I]
H. Boiteux 1966 79 p In FRENCH Presented at the Summer School on Space Phys., Tarbes, France, 19 Aug.–23 Sep. 1966 Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Theories of the atomic model are recalled. Explanation of the formation of line spectra is given and discussed. Width and brightness of the lines are analyzed.
ESRO

N68-31246# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
MANY-BODY PROBLEM WITH GAUSSIAN POTENTIAL [ZADACHA MNOGIKH TEL S GAUSSOVSKIM POTENTSIALOM]
G. F. Filippov 1967 18 p refs In RUSSIAN; ENGLISH summary
(ITF-67-46)

A method developed earlier is applied to calculate the binding energy of Bose and Fermi systems with a Gaussian two-particle potential. The result is presented as a series in the decreasing powers of N.
Author (NSA)

N68-31254# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
ON A GENERALIZATION OF LIE ALGEBRAS
G. L. Stawraki 1967 15 p refs
(ITF-67-21)

Considerations favoring some quasi-simultaneous commutation relations for a set of interacting fermion and boson fields are more general than those for free fields. In these relations commutators and anticommutators of the field operator components are no longer c-numbers but linear functions of the operator components of the same set of fields. The set of such commutation relations constitutes a sort of unassociative algebra more general than Lie algebra. Such algebras are called K-algebras. The mathematical description of these K-algebras and some general properties without any application to physics are given.
NSA

N68-31255# Ludwig-Maximilians-Universitat, Munich (West Germany). Physics Section.
MEASUREMENT OF THE POLARIZATION OF EXTREME ULTRAVIOLET SYNCHROTRON RADIATION WITH A REFLECTING POLARIMETER
G. Rosenbaum, B. Feuerbacher, R. P. Godwin, and M. Skibowski Mar. 1968 15 p refs Prepared jointly with Deut. Elektronen-Synchrotron
(DESY-68/12)

The polarization of extreme uv light provided by a normal-incidence monochromator used with synchrotron radiation from the 6-GeV electron synchrotron DESY has been measured. The measured polarization increases from 82% at 500 Å to 87% at 1000 Å and is in excellent agreement with the calculated polarization of the light incident upon the monochromator grating. A reflecting polarimeter consisting of a polarizer and an analyzer each made of four gold mirrors has been used in the measurement.
Author (NSA)

N68-31273 California Univ., Berkeley.
MEASUREMENT OF THE POLARIZATION PARAMETER IN THE ELASTIC SCATTERING OF NEGATIVE PIONS BY PROTONS FROM 600 TO 3300 MEV/C
Michel Hansroul (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11627

The polarization parameter in $\pi^- p$ elastic scattering has been measured at eleven incident-pion momenta ranging from 600 to 3300 MeV/c. The negative pion beam was focused on a

polarized proton target and the scattered pion and recoil proton were detected in coincidence by counter hodoscopes. The polarization parameter was obtained from a measurement of the difference in counting rates for the target protons' spins parallel and anti-parallel to the normal to the scattering plane. An on-line PDP-5 computer was used in the data encoding and transferred the information onto magnetic tape for later computer analysis. The results serve to fill in some gaps in previous experiments. An attempt to fit the new data and previously available data by means of a phase-shift analysis for energies below 1050 MeV has been successful in finding good fits to the data but has been unsuccessful in that no unique solution has been demonstrated. Dissert. Abstr.

N68-31302# Illinois Univ., Urbana. Dept. of Physics.
DYNAMICAL CALCULATIONS OF PSEUDOSCALAR AND AXIAL VECTOR MESON PARAMETERS USING THE RELATIVISTIC LIPPMAN–SCHWINGER EQUATION
J. Boguta and H. W. Wyld, Jr. Jun. 1968 37 p refs
(Contract N00014-67-A-0305)
(AD-671201)

A multichannel dynamical calculation of pseudoscalar and axial vector meson parameters is performed using the relativistic Lippmann-Schwinger equation. The channel considered is PV to PV. The potential is computed using the usual Feynman rules and the resulting equations are solved on a computer. The cut-off is fixed by adjusting the output mass of one resonance or bound state or the output width to the experimental value. Author (TAB)

N68-31319# Yeshiva Univ., New York. Belfer Graduate School of Science.
COLLECTIVE METHODS FOR SYSTEMS WITH LONG-RANGE COHERENCE Final Report, 1 Oct. 1964–31 Aug. 1967
Gideon Carmi Mar. 1968 181 p refs
(Contract AF 19(628)-4381)
(AFCRL-68-0209; AD-671173)

The concepts of Further Generalized Bose Condensation and Anisotropic ODLRO are formulated, shown equivalent to each other and demonstrated on the model of a thin Bose film. A mechanism is suggested for the occurence of first order phase transitions in quatum plasmas and used for the calculations of the transitions in (a) white dwarfs, (b) submetallic densities of the electron plasma. The model of particles on a circle with interaction-fourier-components 1/k squared is developed in the Random Phase Approximation. The equivalent of plasmons, phonons, Froehlich attraction, superconductivity etc. are explored. The phase transition mentioned in section 2 is shown to occur in the one-dimensional model mentioned in section 3. Exact solutions are obtained for the nonlinear cold plasma and used in analogous problem of nonlinear waves in a disk like galaxy. A system of Bosons interacting with a general two body interaction is being explored within the Extended Random Phase Approximation in the equation of motion method, starting out from collective modes as those introduced by Anderson for superconductivity. Author (TAB)

N68-31320# California Univ., Berkeley. Div. of Applied Mechanics.
THEORY OF AN ELASTIC-PLASTIC COSSERAT SURFACE
P. M. Naghdi, A. E. Green, and R. B. Osborn Jan. 1968 50 p refs
(Contract Nonr-222(69))
(AM-68-1; AD-671200)

The paper is concerned with constitutive equations and related thermodynamical restrictions for an elastic-plastic Cosserat surface. The main developments are carried out in the context of the nonlinear theory. Various special cases, including that with infinitesimal deformation, are discussed. A linear theory of an isotropic, elastic-perfectly plastic Cosserat surface (and plate) is given detailed attention. Author (TAB)

N68-31330# Compagnie Francaise Thomson-Houston, Bagneux (France).
ELECTRON SPIN ECHOS: APPLICATION TO PULSE COMPRESSION [ETUDE DU PHENOMENE D'ECHO DE SPIN ELECTRONIQUES: APPLICATION A LA COMPRESSION D'IMPULSION]
Christian Sourdille (Ph.D. Thesis—Paris Univ.) 18 May 1967 235 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

In order to improve the range and the resolution factor of chirped radars without a prohibitive increment of their crest power, it seems necessary to investigate the possibility of using the spin echo phenomenon. Theoretical and experimental studies have been performed on chirped signals and the possibilities of the spin echo phenomenon, especially on paramagnetic materials. The theory of electron resonance is recalled and paramagnetic materials are analyzed as to their behavior. Test equipment is described and the results obtained are given. A full study has been performed with a mixture of sodium and liquid ammonia. ESRO

N68-31353 Rochester Univ., N. Y.
A MEASUREMENT OF THE PHASE OF THE CP VIOLATING AMPLITUDE FOR $K^0_2 \to \pi^+\pi^-$
David Birnbaum (Ph.D. Thesis) 1967 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-13611

The results of an experimental measurement of the phase of the CP violating amplitude in the decay $K^0_2 \to \pi^+\pi^-$ are presented. The experiment measured this phase directly by observing the interference between the anomalous decay and that of the residual K^0_1 component in a beam that was initally pure K^0. The kaons were produced in a tungsten target by the external proton beam of the Cosmotron. The K^0 contamination was kept to a negligible level by running at an energy of 2.4 Gev, below the threshold for K^0 production. Observations were made of 99 events in the region from 5.5 to 11 K_1 lifetimes. The estimated background contamination is 30 ± 10 events. From the time distributions of the observed events the phase angle was deduced as 70^{+65}_{-56} degrees. Dissert. Abstr.

N68-31368# National Inst. for Metallurgy, Johannesburg (South Africa).
GROWTH OF RADIOACTIVITY IN URANIUM AFTER SEPARATION FROM ITS DAUGHTER PRODUCTS
J. I. W. Watterson and P. K. Faure 27 Apr. 1967 13 p refs
(NIM-162; L.10/65; RR-162)

The radioactivity emitted by pure uranium, and features of its growth to equilibrium, are described. Gamma spectra from newly separated uranium, eight-months-old uranium, and an ore containing uranium in equilibrium with its daughter products, are compared. Some of the consequences for radiometric determination of uranium are described. Author (NSA)

N68-31383# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.
SLOW-NEUTRON SCATTERING AND MOLECULAR DYNAMICS OF THE LIQUID STATE [DIFFUSIONE DI NEUTRONI LENTI E DINAMICA MOLECOLARE DELLO STATO LIQUIDO]
V. Ardente, G. F. Nardelli (Milan Univ.), and L. Reatto (Applicazioni e Ric. Sci., Milan) Brussels Jun. 1968 50 p refs In ITALIAN; ENGLISH summary Prepared jointly with Applicazioni e Ric. Sci., Milan

(Contracts EURATOM-140-63-4 ISPI; EURATOM-196-65-4 ISPI)
(EUR-4037.I) CFSTI: HC $3.00/MF $0.65

This report deals with the general theory of slow-neutron scattering from a liquid and its connection with the molecular dynamics of the liquid state. A review is given of various models that have been proposed for describing the behavior of classical liquids, in particular the scattering function and the velocity self-correlation function; consideration is given both to the individual-particle aspects of molecular dynamics, which are significant as regards incoherent scattering, and to the collective aspects, which are significant for coherent scattering. Also discussed are the new data on molecular dynamics that have been deduced from computer experiments, and the results thus obtained for the velocity self-correlation function are used to effect a comparison, on the basis of the impeded translator model recently proposed with the corresponding predictions. Author

N68-31401# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
DETERMINATION OF THE PION AND CONSPIRATOR RESIDUES AND TRAJECTORIES, IN POSITIVE PION PHOTOPRODUCTION FROM CONTINUOUS MOMENT SUM RULES
P. Di Vecchia, F. Drago, C. Ferro Fontan (Intern. Centre for Theoret. Phys.), R. Odorico (Trieste Univ.), and M. L. Paciello (Rome Univ.) 4 Jun. 1968 8 p refs *Its* Nota Interna No. 403
(LNF-68/33) CFSTI: HC $3.00/MF $0.65

Using continuous moment sum rules we obtain a clear evidence for the pion conspiracy. We find the pion and conspirator residues and trajectories, which reproduce with accuracy the forward peak in the high-energy differential cross section. Author

N68-31402# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
SHORT RANGE DYNAMICAL CORRELATIONS IN Li 6 AND O 16 NUCLEI FROM ELASTIC ELECTRON SCATTERING
C. Ciofi degli Atti 30 Mar. 1968 11 p refs
(ISS-68/10) CFSTI: HC $3.00/MF $0.65

The effect of two-body correlations on the electron elastic form factor was considered for ^{6}Li and ^{16}O nuclear. Author

N68-31429# Missouri Univ., Rolla. Cloud Physics Research Center.
EXPANSION CLOUD CHAMBER TECHNIQUE FOR ABSOLUTE AITKEN NUCLEI COUNTING
J. L. Kassner, Jr., J. C. Carstens, M. A. Vietti, A. H. Bierman, Paul C. P. Yue et al [1967] 93 p refs Presented at the Intern. Atmospheric Nuclei Instr. Workshop, Clermont Univ., France, 8–23 Sep. 1967; Sponsored by Intern. Assoc. of Meteorology and Atmospheric Phys.
(Grant NSF GA-428)

The design of expansion cloud chambers is of considerable interest to investigators desiring to make accurate determinations of the Aitken nuclei spectrum. Cloud chamber design, at its best, involves a series of compromises between competing factors. Careful consideration must be given to the effects of heat flow from the walls, propagation of errors in the determination of the supersaturation from primary measurements, droplet growth which ensues during the expansion, and details of observing the condensed droplets. Recent developments in expansion cloud chamber technique applicable to condensation counter measurements are discussed. Techniques for circumventing the deleterious effects of heat conduction from the walls of the chamber are described. A method for accurately determining the supersaturation in the presence of dropwise condensation is presented. The design for an expansion cloud chamber capable of accurate determinations of the Aitken nuclei spectrum is given along with details pertaining to its operation. Author

N68-31433# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
PRELIMINARY MEASUREMENTS OF THE NUCLEAR REACTION C 12(γ, 2 PROTON)Be 10 [MISURE PRELIMINARI DELLA REAZIONE NUCLEARE C 12(γ, 2 PROTON)Be 10]
G. P. Capitani 8 Mar. 1968 33 p refs In ITALIAN; ENGLISH summary
(ISS-68/8) CFSTI: HC $3.00/MF $0.65

The present report deals with preliminary measurements of the cross section of the reaction $^{12}C(\gamma, 2p)^{10}Be$, carried at the Frascati electronsynchrotron. The results of the measurements are in disagreement with preliminary measurements of Weinstein et al. The existence of this disagreement, together with more fundamental theoretical reasons discussed in the first part of this report, bring to the necessity of further experimentation. Author

N68-31507# Comitato Nazionale per l'Energia Nucleare, Roma (Italy).
THE CIAP-1D CODE
I. Dal Bono, V. Leproni, and M. Salvatores 1968 21 p refs
(RT/FI(68)9-PRV-r-(67)14) CFSTI: HC $3.00/MF $0.65

The analytic basis is presented for the CIAP-1D program (calculation of importance for analysis of perturbation in 1 dimension) written in FORTRAN for the IBM 7094 computer. The program calculates important functions relative to linear functionals with real and adjoint neutron fluxes in the one-dimensional perturbation analysis of fast reactors. A general description of CIAP-1D includes the input data list, output data list, and two subroutine descriptions. One subroutine calculates real and adjoint neutron fluxes, and the other iteratively computes global importance and real flux maps. A sample problem is included. D.H.B.

N68-31521# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
INFRARED RADIATIVE CORRECTIONS FOR RESONANT PROCESSES
G. Pancheri 14 May 1968 11 p refs *Its* Nota Interna No. 398
(LNF-68/26) CFSTI: HC $3.00/MF $0.65

A non-perturbative analysis of the bremsstrahlung emitted in the formation of resonant infrared processes is performed by a semiclassical treatment in order to define the bond factor which characterizes it. Proposed is a generalization of this first approximation result to cover higher powers and to free the treatment of resonant states from the limitations of the perturbation theory. G.G.

N68-31523# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
LARGE ANGLE PROTON–PROTON ELASTIC SCATTERING
M. Greco 17 May 1968 11 p refs *Its* Nota Interna No. 397
(LNF-68/25) CFSTI: HC $3.00/MF $0.65

A new formula for differential cross sections in elastic nucleon–nucleon scattering is formed by considering the following assumptions: (1) For hard collisions each process is described in terms of the entropy which grows up, with the different channels that are open, to a maximal value which depends on the specific process; and (2) the number of channels open, and therefore the entropy, are an increasing function of the momentum transfer for fixed energy in the center of mass system. The formula is valid in asymptotic conditions and agrees with experimental results on asymptotic proton–proton scattering data. G.G.

N68-31542# Michigan Univ., Ann Arbor. Dept. of Physics.
A MEASUREMENT OF THE SPIN EXCHANGE CROSS SECTION OF Cs 133, Rb 87, Rb 85, K 39 AND Na 23

Neil W. Ressler (Ph.D. Thesis) Sep. 1967 111 p refs
(Contract AT(11-1)-1112)
(Rept.-04941-4-T; COO-1112-159) CFSTI: HC $3.00/MF $0.65

Electron paramagnetic resonance was used to measure the spin-exchange cross sections for ^{133}Cs–^{133}Cs, ^{87}Rb–^{87}Rb, ^{85}Rb–^{85}Rb, ^{39}K–^{39}K, and ^{23}Na–^{23}Na collisions. Density measurements were made by comparing the magnetic resonance signal of the alkali with that of a calibrated standard. The cross sections obtained are as follows: ^{133}Cs, $2.06^{+0.20}_{-0.35} \times 10^{-14}$ cm^2; ^{87}Rb, $1.85^{+0.20}_{-0.30} \times 10^{-14}$ cm^2; ^{85}Rb, $1.92^{+0.20}_{-0.30} \times 10^{-14}$ cm^2; ^{39}K, $1.45^{+0.18}_{-0.25} \times 10^{-14}$ cm^2; ^{23}Na, $1.03^{+0.10}_{-0.20} \times 10^{-14}$ cm^2.

Author (NSA)

N68-31543# Michigan Univ., Ann Arbor.
A HIGH RESOLUTION GAMMA-RAY SPECTROSCOPIC STUDY OF THE DECAYS Ba 133 → Cs 133 AND Ge 77 → As 77
Denis Philip Donnelly (Ph.D. Thesis) 1967 110 p refs
(Contract AT(11-1)-1112)
(COO-1112-165) CFSTI: HC $3.00/MF $0.65

The energy levels of ^{77}As and ^{133}Cs were investigated by high-resolution measurements of the energies and intensities of gamma rays from the beta decay of ^{77}Ge and the electron-capture decay of ^{133}Ba, respectively. A level scheme with 28 excited states and 74 transitions is proposed for ^{77}As. A decay scheme is proposed for ^{133}Ba. Spin assignments and branching ratios for a number of levels in ^{133}Cs were determined; transition multipolarities and rates were also obtained. Internal conversion coefficients for ^{133}Cs were calculated using the gamma intensities obtained and information from other sources on the conversion-electron intensities. NSA

N68-31547# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
INVESTIGATION OF THE DYNAMICAL PROPERTIES OF LIQUID-GAS SYSTEMS BY COHERENT COLD NEUTRON SCATTERING NEAR THE CRITICAL POINT
L. Bata and N. Kroo 11 Apr. 1968 14 p refs
(KFKI-10/1968)

The critical points for CO_2 were determined by small-angle scattering experiments using Be-filtered cold neutrons and a small-angle scattering spectrometer. Similar measurements were made for CS_2 using neutrons with $\lambda = 1.15$ Å and a neutron diffractometer. Inelastic scattering data were taken at different angles and temperatures using a time-of-flight spectrometer. It was found that scattering spectra measured at different angles cannot be described by a simple Lorentzian function. Large inelastic contributions were observed near the quasi-elastic spectra and were explained by the presence of sound modes considered in terms of a hydrodynamical approximation as Brillouin modes. NSA

N68-31554# Forsvarets Forskningsanstalt, Stockholm (Sweden).
COMPRESSED ATOMS. 2: APPLICATION TO Al AND Fe
K.-F. Berggren and A. Froeman Mar. 1968 36 p refs
(FOA-4-C-4346-23)

The spherical cellular model, which treats an atom confined to a finite spherical volume, was used to make a quantum-mechanical study of some properties of Al and Fe at various compressions. The calculations were performed with a Thomas–Fermi potential and an approximate self-consistent potential in the Hartree–Fock–Slater equations. The pressure–density relation at 0°K and some electronic properties, e.g., band structure and specific heat were calculated and compared with results of experments and of other theories. It is shown that spherical cellular model in its present version does not give reliable quantitative results, but qualitatively, it gives an improvement on the statistical models. Author (NSA)

N68-31557# General Electric Co., Schenectady, N. Y.
RAUMZEIT: A PROGRAM TO SOLVE COUPLED TIME-DEPENDENT NEUTRON DIFFUSION EQUATIONS IN ONE SPACE DIMENSION
Cyrus H. Adams and Weston M. Stacey, Jr. 31 Jul. 1967 47 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6728) CFSTI: HC $3.00/MF $0.65

The computer program RAUM, which solves systems of static, one-dimensional diffusion-type equations, was modified to solve transient problems by either of two methods, the time-integrated technique or a difference approximation. The original capabilities of the program remain intact, but now a static (eigenvalue) solution may be followed by a time-dependent calculation which uses initial conditions derived from the static problem. The modified code, RAUMZEIT, solves systems of up to six time-dependent diffusion-type partial differential equations in slab, spherical, and cylindrical geometries with as many as six delayed neutron precursor groups. Parameters appearing in the equations may be specified as a function of time, making possible, for example, the calculation of rod motion and reactor oscillator transients starting from critical configurations. In addition to solving multigroup neutron diffusion problems, the code has some limited use in space-time flux synthesis problems and the analysis of other diffusion phenomena. Author (NSA)

N68-31568# Eidgenoessisches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
PARAMAGNETIC SCATTERING OF NEUTRONS BY TRIVALENT RARE-EARTH IONS IN AN OCTAHEDRAL CRYSTAL FIELD
A. Furrer, W. Haelg, and T. Schneider [1967] 11 p refs
Presented at the Swiss Phys. Soc. Conf., Schaffhausen, Switzerland
(SM-104/5; CONF-670969-1)

The energy distribution of neutrons scattered by trivalent rare-earth compounds has been measured at room temperature. The paramagnetic lines, corresponding to transitions within the ground-state multiplet of the rare-earth ion split by the octahedral crystal field, are superposed on the nuclear parts of the energy distribution. Experimental conditions and computational methods are described to determine the position and shape of the paramagnetic lines. The resulting values of the crystal field splitting and the paramagnetic line-width are discussed. Author (NSA)

N68-31571# Oak Ridge National Lab., Tenn.
MECHANISM OF INTERACTION OF FAST DEUTERONS WITH NUCLEI
V. S. Barashenkov, K. K. Gudima, and V. D. Toneev [1968] 18 p refs Transl. into ENGLISH from the Rept. JINR-P2-3356 Submitted for publication
(ORNL-TR-1907) CFSTI: HC $3.00/MF $0.65

A theoretical investigation of the interaction of a deuteron with a nucleus at high energy was made considering a nucleus with a sharp boundary (radius = $1.4A^{1/3} \times 10^{-13}$ cm) and assuming that only those deuterons react with the nucleus for which the center of gravity passes at a distance not greater than R + D/2 from the center of the target nucleus. The mean diameter D of the deuteron was taken to be 4.3×10^{-13} cm. It was found that the smearing of the nuclear boundary must be taken into account. NSA

N68-31573# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
QUASI-ELASTIC ELECTRON SCATTERING ON LIGHT NUCLEI
A. Malecki and P. Picchi 27 May 1968 19 p refs
(LNF-68/29) CFSTI: HC $3.00/MF $0.65

Quasi-elastic electron scattering on nucleons bound in light nuclei is considered using the electron-nucleon interaction of Mc Voy and Van Hove. The shell model with the harmonic oscillator potential is assumed to describe the bound nucleons in the initial state. The outgoing nucleon is represented by a plane wave and the probability of the nucleon reabsorption is taken into account by means of a reduction factor. Comparison of the quasi-elastic scattering contribution with the inelastic, experimental cross-section for He^4, C^{12} and O^{16} is presented. The importance of possible effects of short range nucleon-nucleon correlations is discussed. Author

N68-31575# United Kingdom Atomic Energy Authority, Culham (England).
EXISTENCE AND PROPERTIES OF TRIATOMIC DEUTERIUM MOLECULAR JETS
F. Marcel Devienne [1967] 6 p Transl. into ENGLISH from Comp. Rend. (France), no. 264, ser. A and B, 17 May 1967 p 1400–1403
(NP-TR-1637; CTO-454) CFSTI: HC $3.00/MF $0.65

By charge exchange of D_1+, D_2+, and D_3+ ion beams extracted from a hf source, molecular jets having different properties are obtained. In particular, the variation of the gain of a zinc sulfide photoscintillator shows the existence of D_3^0 molecules in the molecular jet obtained by charge exchange of D_3+. Author (NSA)

N68-31577# Argonne National Lab., Ill.
MULTI-PARAMETER INVESTIGATIONS OF FAST FISSION FRAGMENTS [MNOGOPARAMETROVYE ISSLEDOVANIYA OSKOLKOV PRI DELENII YADER BYSTRYMI NEITRONAMI]
P. P. D'yachenko and B. D. Kuz'minov Apr. 1968 10 p refs Transl. into ENGLISH from STI/PUB-101, vol. 1 Rept. Presented at the Symp. on Phys. and Chem. of Fission, Salzburg, 22–26 Mar. 1965
(ANL-TRANS-606; CONF-650301-34; STI/PUB-101, V. 1) CFSTI: HC $4.00/MF $0.65

Particular attention is given to the characteristics of symmetric fission of ^{238}U, and it is found that when tails appear in the apparatus spectra of the fission fragments, there occur in the symmetric mass-region pulses with a most probable total energy of ≈120 MeV. Actual symmetrical fission events correspond to a total mean energy of ≈155 MeV. The kinetic energy of paired fragments was measured using two surface-barrier silicon counters. The impulses are analyzed for amplitude by a two-dimensional 128 × 128 channel analyzer with a ferrite memory. The neutron source used was the BR-5 fast neutron reactor, the mean energy of the fast neutron spectrum being ≈250 keV. Layers of fissile isotopes with a thickness of 20 to 30 $\mu g/cm^2$ were used. The fission of ^{238}U by thermal neutrons gave an experimental curve for the mass yield with a 250:1 ratio between peak and valley. Comparison of the characteristics of the fragments showed no noticeable difference in the fission of ^{235}U by thermal and fast neutrons. Author (NASA)

N68-31586# Hungarian Academy of Sciences, Budapest.
NEUTRON SCATTERING INVESTIGATIONS OF THE DYNAMICS OF CRITICAL STATE IN IRON
J. Gordon, Eva Kiedi-Koszo, L. Pal, and I. Vizi 8 Apr. 1968 13 p refs
(KFKI-8/1968)

The inelasticity of critical scattering was investigated in iron with the use of a pulsed monochromatic neutron beam at the IBR-1 reactor in Dubna. The measurements covered the temperature range $-2.5 \times 10^{-3} \leq \tau \leq 6.5 \times 10^{-3}$ where $\tau = T/T_c - 1$ and the critical temperature was approached within $\tau < 5 \times 10^{-4}$. The slight temperature dependence of the inelasticity was confirmed for $\rho = 5.7 \times 10^{-2}$, Å^{-1}, but the observed diffusion constant was found to be temperature-independent and higher ($\mu = 16.5$) than the value ($\mu = 11$) reported earlier by other authors. Author (NSA)

N68-31588# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
X-RAY TELESCOPE USING ASYMMETRIC BRAGG CRYSTAL-PLANE DIFFRACTION
F. W. Lyle and R. G. Bingham May 1968 14 p refs
(DI-82-0720; AD-671189)

A cone covered on the inner surface with a mosaic of small crystals is used to concentrate parallel x-rays onto one small detector. Optimized cones of 20-40 cm diameter with lithium fluoride crystal provide gains of 100 or better from 5-20 KeV. The estimated minimum detectable photon flux at 8 KeV is 3 x 10 to the -5 power photons/(sq cm x sec x KeV). Author (TAB)

N68-31590# General Dynamics Corp., San Diego, Calif.
DSZ AND PREDSZ: FORTRAN 4 CODES FOR COMPUTING SLOWING DOWN SOURCES
J. M. Neill 25 Mar. 1968 16 p refs
(Contract AT(04-3)-167)
(GA-8556) CFSTI: HC $3.00/MF $0.65

The mathematical formulation of the revised DSZ program, which computes energy and position dependent slowing-down sources, is outlined. The revised code eliminates the previous overestimate of the contribution to the source terms in the lowest energy group possible for each nuclide, and a more accurate treatment for hydrogen is also included. The PREDSZ code, which computes a smoothed indium foil activity and the gradient of the activity from the measured distribution of foil activities, is also briefly discussed. NSA

N68-31595# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE WIDTH OF HADRONS
G. Matthiae 15 Apr. 1968 15 p refs
(ISS-68/11) CFSTI: HC $3.00/MF $0.65

A calculation of the average value of the width of hadrons as a function of their mass is reported. The approach, which makes use of the mass spectrum of hadrons as predicted by the thermodynamical model is based on the application of detailed balance. Author

N68-31611# Iowa State Univ. of Science and Technology, Ames.
LECTURES ON DESCRIPTION OF PARTICLES WITH ANY SPIN AND WITH INTERNAL SYMMETRY
R. H. Good, Jr. Apr. 1968 40 p refs
(Contract W-7405-ENG-82)
(IS-1815) CFSTI: HC $3.00/MF $0.65

A free particle with rest mass and spin s = 0, 1/2, 1, ... can be described conveniently by a $2(2s + 1)$—component wave function of Lorentz type (0, s) ⊗ (s, 0). An advantage of this description is that it simplifies field-theory-type calculations of reactions. A review of the description is given including some of the discussions and proofs that have not been written up before. The c-number theory and the quantization process are discussed in detail. The charge conjugation quantum number and the inclusion of isospin coordinates are also covered. Author (NSA)

N68-31612# Michigan Univ., Ann Arbor.
ASPECTS OF THE THEORY OF ELECTRONS IN LIQUID HELIUM
Shou-yih Wang (Ph.D. Thesis) 1967 80 p refs
(Contract AT(11-1)-1112)
(COO-1112-158) CFSTI: HC $3.00/MF $0.65

Some aspects of the theory of electrons in liquid helium are reported. The bubble model for the electron is described, in which the electron sees a spherical square well potential of finite

depth in the liquid helium. The Wigner–Seitz model is employed in determining the barrier height for the electron. A systematic, self-consistent calculation of bubble parameters is presented. Since the surface tension is required to determine the size of the bubble and since the surface tension is not known, this question is left open. The photoejection cross section as a function of photon energy was calculated for the process of photoejection of electrons from the bubble states. This cross section is found to be a sensitive function of bubble size. The theory of phonon-bubble scattering is presented, using the self-consistent calculation of the bubble parameters. The relevant cross section including resonant phenomena is calculated. The expression for the phonon-limited mobility of the negative ion was derived both from Arkhipov's approach and from the Boltzmann Equation with the same result. Author (NSA)

N68-31660*# Scripta Technica, Inc., Washington, D. C.
DETECTION OF HARD BETA RAYS IN WATER THROUGH THE CERENKOV EFFECT [DETECTION DES β DURS DANS L'EAU PAR EFFET CERENKOV]
Bernard Turck (Ph.D. Thesis) NASA Aug. 1968 67 p refs Transl. into ENGLISH of the Rept. CEA R-2915, 1966 p 1–66
(Contract NASw-1694)
(NASA-TT-F-11793) CFSTI: HC $3.00/MF $0.65 CSCL 07E

Describes equipment capable of detecting $8 \cdot 10^{-8}$ μ c/cc of strontium–yttrium 90 in water (i.e., one-tenth of the maximum permissible concentration) within a time of few minutes. This equipment is especially useful for monitoring water quality, because it is simple to manufacture and operate. Moreover, the apparatus permits identification of some individual radioactive elements in water by means of an energy discrimination technique. Author

N68-31661*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.
THE CONTRIBUTION OF PERTURBER RADIATION TO THE SHAPES OF SPECTRAL LINES BROADENED BY ELECTRON IMPACTS
D. D. Burgess Jul. 1968 44 p refs
(Grant NGL-22-007-006)
(NASA-CR-96147; SR-29) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Theories of electron impact broadening have previously neglected the radiation produced by the perturbing electrons. In this paper a theory is developed to take the perturber radiation into account, and so to evaluate possible interference terms. These may lead to observable asymmetries of lines of ionized emitters. Author

N68-31663# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
LOW ENERGY PART OF THE α PARTICLE SPECTRUM FROM TRIPARTITION OF U^{236} [NISKOENERGETYCZNA CZESC WIDMA CZASTEK α EMITOWANYCH W TRYPARTYCJI U^{236}]
J. Chwaszczewska, M. Dakowski, T. Krogulski, E. Piasecki, M. Sowinski et al 1968 11 p refs Submitted for publication
(Rept.-911/IA/II/PL) CFSTI: HC $3.00/MF $0.65

Measurement of the low energy part of the spectrum of α particles emitted in thermal neutron fission of 235U was performed with a telescope counter. The upper limit for the cross section of the $^{235}U(n,\alpha)$ 232Th reaction was estimated to be 3 mb for the transition to the ground state and 2 mb for the transition to the excited state up to 5 MeV. Author

N68-31664 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
STUDIES ON FIREBALL-MODEL [ANALIZA MODELU FIREBALL' I]
M. Miesowicz 1968 40 p refs Presented at the Meeting on the Fireball Model, Moscow, 11–15 Mar. 1968
(Rept.-915/VI/PH) CFSTI: $3.00

Experimental facts are discussed which can be interpreted in terms of fireball emission in hadron interactions with energies in the interval 10 GeV–10^5 GeV. A detailed analysis of emulsion experiments at energies 10^3 GeV–10^4 GeV is presented. A discussion of the role of isobars in particle production at $\approx 10^3$ GeV is given. Limitation on isobar mass and decay multiplicities resulting from observed anisotropy of ionization particles are discussed. The possibility of investigating the physical nature of fireballs by studying interactions of nucleons with heavy nuclei is discussed. Author

N68-31669# California Inst. of Tech., Pasadena. Gates and Crellin Labs. of Chemistry.
REACTION OF MONOENERGETIC DEUTERIUM ATOMS WITH HYDROGEN MOLECULES
Aron Kuppermann [1967] 17 p refs Presented at the 4th Nobel Sym., Stockholm
(Contract AT(04-3)-532)
(CALT-532-17; CONF-670838-1)

The following topics are discussed: reaction cross sections and rate constants, experimental methods for determining reaction cross sections, and theoretical analysis of monochromatic atom reactions. The concept of the reaction cross section is developed from considerations of the rate of reaction in constant energy interaction of molecular pairs. The interaction is assumed to be adiabatic so that the Born–Oppenheimer approximation is applicable. The time-independent Maxwell–Boltzmann distribution function is used to relate the bimolecular thermal rate constant K(T) to the time-independent rotationally averaged reaction cross section σ(E). Previous methods are indicated for determining σ(E) from K(T) for the reaction $D + H_2 \rightarrow DH + H$. The reaction of ground-state D atoms with a thermal H_2 gas at temperatures less than 1000°K is studied. NSA

N68-31699# Illinois Univ., Urbana. Dept. of Physics.
CURRENTS AS COORDINATES IN NON-RELATIVISTIC QUANTUM MECHANICS
W. J. Pardee, L. Schlessinger, and Jon Wright [1968] 27 p refs
(Contract N00014-67-A-0305-0005; Grant NSF GP-6198)
(AD-671202)

The formulation of non-relativistic quantum mechanics using currents and densities as coordinates is investigated. A general solution for a single particle theory is presented, and several many body problems are discussed. Author (TAB)

N68-31727# Argonne National Lab., Ill. Chemistry Div.
PROGRAMS FOR ATOMIC-STRUCTURE CALCULATIONS
C. Froese Fischer (Brit. Columbia Univ.) and M. Wilson Jan. 1968 59 p refs
(Contract W-31-109-ENG-38)
(ANL-7404) CFSTI: HC $3.00/MF $0.65

Computer programs used for atomic structure calculations are described and listed. Sample data for each are also presented. Author (NSA)

N68-31732# Paris Univ., Orsay (France). Linear Accelerator Lab.
A STUDY OF ELECTRON-POSITION ANNIHILATION INTO POSITIVE PION NEGATIVE PION AT 775 MeV WITH THE ORSAY STORAGE RING
J. E. Augustin, J. C. Bizot, J. Buon, J. Haissinski, D. Lalanne et al Oct. 1967 11 p refs
(LAL-1181; PB-177845) CFSTI: HC $3.00/MF $0.65

Results are presented of a preliminary measurement of the pion–pion cross section of the 'electron+positron to positive-pion+negative-pion' reaction at an energy of 775 MeV. This was the first high-energy experiment to be achieved with the Orsay Storage Ring. USGRDR

N68-31735# Michigan Univ., Ann Arbor.
GAMMA-RAY SPECTROSCOPY ON THE N=82 NUCLEAR ISOTONES: Ba 139, Ce 140, Pr 141, AND Nd 142
Helmut Willy Baer (Ph.D. Thesis) 1967 142 p refs Sponsored in part by the Detroit Evening News Assoc.
(Contract AT(11-1)-1112)
(COO-1112-167) CFSTI: HC $3.00/MF $0.65

Gamma radiation from the N=82 nuclei ^{139}La, ^{140}Ce, ^{141}Pr, and ^{142}Nd was investigated using the techniques of gamma-ray spectroscopy. Gamma-ray energies and intensities were measured with a 2-m curved-crystal spectrometer and Ge(Li) detectors. Gamma-ray decay sequences were determined by γ-γ coincidence measurements. The following results were obtained. The energy values 165.854±0.012, 145.4498±0.0049, and 1575.42±0.39 keV were determined for the excitation energies of the first excited states in ^{139}La, ^{141}Pr, and ^{142}Nd, respectively. A total of 26 gamma-ray energies and intensities were measured in the decay of ^{140}La to levels in ^{140}Ce. A decay scheme is presented which includes 15 excited levels and 28 γ transitions. Twelve excited levels were found to be populated by β^- decay; log-ft values were determined using partial β transition probabilities and end-point energies. The multipole character of most of the γ transitions could be determined when the present data were combined with recently published conversion electron data. Author (NSA)

N68-31743# Michigan Univ., Ann Arbor.
CONVERSION ELECTRON SPECTRA: A LINE SHAPE ANALYSIS FOR PERMANENT MAGNET SPECTROGRAPHS
Cecil Gerald Diethrich (Ph.D. Thesis) 1967 121 p refs
(Contract AT(11-1)-1112)
(COO-1112-168) CFSTI: HC $3.00/MF $0.65

Computer programs were written to perform a detailed analysis of the effects of variations in source width and height, slit width, source-slit-plate orientation, and radius of electron trajectories on recorded line shapes. The information obtained from the computer analysis was used in redesigning the camera and vacuum chamber of the spectrometer. The modified system was then used to study the internal conversion electron spectra from the decay of ^{109}Cd, ^{192}Ir, and ^{140}La. NSA

N68-31744# Kansas Univ., Lawrence. Nuclear Physics Lab.
THE S 32(p, γ)Cl 33 REACTION
James W. Gordon May 1968 90 p refs
(Contract AT(11-1)-1120)
(COO-1120-71) CFSTI: HC $3.00/MF $0.65

The energy levels of ^{33}Cl were investigated using the reaction ^{32}S(p,γ)^{33}Cl at incident proton energies of 0.475 to 3.215 MeV. Gamma spectra were taken at the resonances using Ge(Li) and NaI(Tl) detectors. Gamma angular distributions were also measured; the data were fitted with Legendre expansions. The relative intensities and branching ratios for a number of gamma transitions were determined. Evidence for the existence of seven previously unreported states in ^{33}Cl at excitation energies of 1990±4, 2347±10, 2979±4, 4440±6, 4474±6, 4757±6, and 4844±6 keV was obtained. The spins of the elvels at 4474, 4757, and 4844 keV were uniquely determined to be 3/2, 5/2, and 3/2, respectively. The spin of the resonance state at 4440-keV excitation energy is either 1/2 or 3/2. An ambiguity also remains of a spin assignment of 5/2 or 7/2 for the second excited state at 1990 keV. Similarly, assignments of 5/2 and 7/2 for the seventh excited state at 2979 keV were considered; the 7/2 assignment appears to be more consistent with the data. Multipole mixing ratios for a number of gamma transitions in ^{33}Cl were also determined. A level scheme for ^{33}Cl that includes all the data is proposed. NSA

N68-31746# Illinois Univ., Urbana. Dept. of Physics.
[ON PARTICLE PHYSICS] Annual Progress Report
Apr. 1968 36 p refs
(Contract AT(11-1)-1195)
(COO-1195-124) CFSTI: HC $3.00/MF $0.65

The high-energy physics research covers experiments using spark chambers and bubble chambers including CP violations, meson decays and interactions, branching ratios, and resonance production. Also spark chamber development and the development of a bubble chamber film analysis system are described. NSA

N68-31748# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. PLA Nuclear Physics Group.
DESIGN OF BEAM LINES WITH HIGH RESOLVING POWER
P. A. Reeve 1967 20 p refs
(RHEL/R-149) HMSO: 4s 6d

A systematic method of designing beam lines, which reduce the energy spread and emittance of beams from accelerators to match target requirements, is discussed. Author (NSA)

N68-31814# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
APPLICATIONS OF THE COULOMB BACKSCATTERING OF HEAVY CHARGED PARTICLES. 1: THICKNESS MEASUREMENTS OF THIN FOILS AND SURFACE LAYERS [ZASTOSOWANIA ROZPRASZANIA KULOMBOWSKIEGO CIEZKICH CZASTEK NALADOWANYCH. 1: POMIARY GRUBOSCI CIENKICH FOLII I WARSTW POWIERZCHNIOWYCH]
A. Turos and Z. Wilhelmi 1968 50 p refs Submitted for publication
(Rept.-892/I/PL) CFSTI: HC $3.00/MF $0.65

A nondestructive method of investigating surface layers in which use is made of the phenomena occurring during backscattering of charged particles in the Coulomb field of the nucleus has been developed. The analysis of energy spectra of particles scattered at an angle of 165° renders the determination of the chemical composition and thickness of the sample investigated possible. The present report deals with the thickness measurements of surface layers and thin foils. The measurements performed, in which alpha particles, ^{3}He particles and deuterons with energies ranging from 1 to 3 MeV were used, have shown that the thickness can be determined with an accuracy of about 5% if the thickness of the samples varies from 0.05 mg/cm^2 to 10 mg/cm^2. Author

N68-31816# Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.
MOLECULAR DYNAMICS IN GASEOUS AND SOLID METHANE STUDIED BY THE INELASTIC NEUTRON SCATTERING METHOD [BADANIE DYNAMIKI MOLEKULARNEJ W GAZOWYM I STALYM METANIE PRZY POMOCY METODY NIESPREZYSTEGO ROZPRASZANIA NEUTRONOW]
A. Bajorek, I. Natkaniec, K. Parlinski, M. Sudnik-Hrynkiewicz, J. A. Janik et al May 1968 32 p refs
(INP-608/PS) CFSTI: $3.00

Measurements of the neutron scattering double differential cross section for gaseous methane and for solid methane were performed. The results for gaseous methane were compared with the Rahman–Griffing theory. A deviation from this theory was

found for the 30° scattering angle. After estimation of the possible effect of multiple scattering, this deviation was interpreted as being caused by molecular interactions in gaseous CH_4. The results for solid methane were compared with the theory, in which free molecular rotations were assumed, whereas the translations were replaced by a Debye vibrational spectrum corresponding to the Debye temperature 48°K. In the experimental data no distinct discrete rotational peaks were observed at the temperature of measurements of 80°K. This lack of rotational peaks indicates some rotational hindrance (but by no means leading to a torsional oscillation). A rather good agreement of both theoretical and experimental scattered intensities at small energy transfers favors the choice of the translational model assumed. Author

N68-31817# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
INCOHERENT MULTIPLE PRODUCTION OF PARTICLES IN COLLISIONS OF 200 GeV PIONS WITH NUCLEI OF PHOTOGRAPHIC EMULSION [NIEKOHERENTA WIELORODNA PRODUKCJA CZASTEK W ZDERZENIACH MEZONOW PI O ENERGII 200 GeV Z JADRAMI EMULSJI FOTOGRAFICZNEJ]
J. Gierula and S. Krzywdzinski 1968 19 p refs Submitted for publication
(Rept.-902/VI/PH) CFSTI: $3.00

An unbiased sample of 135 interactions of pions with energy of about 200 GeV with emulsion nuclei is investigated. Multiplicity distributions, average inelasticity coefficient and angular distributions of secondary particles are analyzed. A cascade model of the mechanism of particle production in collision with a heavy nucleus is proposed. The possibility of the estimation of the lifetime of the fireball is pointed out. Author

N68-31885# Laboratoire de Physique Theorique et des Hautes Energie, Orsay (France).
DEDUCTION OF TOLLER'S CLASSIFICATION FROM ANALYTICITY OF HELICITY AMPLITUDES AND FACTORIZATION
A. Capella, A. P. Contogouris, and J. Tran Thanh Van Jul. 1968 8 p refs
(Rept.-68/21) CFSTI: HC$3.00/MF$0.65

The group-theoretical classification of Regge trajectories is deduced from the analyticity properties of the individual helicity amplitudes and the factorization theorem. Author

N68-31886 Atomic Energy Commission Research Establishment, Riso (Denmark). Dept. of Reactor Physics.
DESCRIPTION OF THE SOFIE-3 PROGRAMME NO. P-405
P. L. Oelgaard Aug. 1967 53 p refs
(RISO-M-637) CFSTI: HC$3.00/MF$0.65

The SOFIE-III program is intended for investigations of the size of the Sphere of Importance around a neutron moisture probe, i.e. the size of the effective volume around the probe, in which the moisture concentration is determined. The program is based on three-group diffusion theory. The geometrical arrangment is a point neutron source surrounded by two concentric zones the outer of which extends to infinity. The thermal neutron detector is either a point detector at the source or a line detector with its axis through the source, but situated outside the source. The inner zone is always a soil-moisture mixture, while the outer is either a soil-moisture mixture or vacuum. Author

N68-31900# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ALLOWED β-DECAY IN SPHERICAL NUCLEI [RAZRESHENNYI BETA-RASPAD V SFERICHESKIKH YADRAKH]
K. Alexander 1968 21 p refs In RUSSIAN
(JINR-P6-3785)

In heavier spherical nuclei, allowed beta transitions with low log-ft values can be assumed to connect the partners of the spin-orbit splitting of shell-model levels in the proton and neutron systems, respectively. Using this rule, such transitions are analyzed in the mass region $90 < A < 140$. The problem of what conclusions can be drawn from allowed beta decay on the two- and three-quasiparticle structure of excited states is studied. Examples of this kind are discussed for the nuclei ^{93}Mo, ^{94}Mo, ^{116}Sn, ^{116}Sn, ^{118}Sn, ^{120}Sn, ^{138}Ce, and ^{140}Pm. Author (NSA)

N68-31906# Stanford Linear Accelerator Center, Calif.
CALCULATIONS OF THE THREE-NUCLEON LOW ENERGY PARAMETERS
H. Pierre Noyes and H. Fieldelday (Atomic Energy Board, Pretoria) Apr. 1968 73 p refs Presented at the Conf. on Three-Particle Scattering in Quantum Mech., College Station, Tex., 4–8 Apr. 1968 Prepared jointly with Atomic Energy Board, Pretoria
(Contract AT(04-3)-515)
(SLAC-PUB-409; CONF-680429-1) CFSTI: HC$3.00/MF$0.65

Since exact calculations of the three nucleon low energy parameters using separable models assume nuclear forces which do not reproduce experimental two-nucleon data, and variational calculations with realistic forces have not converged, comparison of either type of calculation with experiment is premature. However, the exact calculations can be used for parameter studies, and these studies shed some light on which features of the two nucleon interaction must be known in order to make reliable calculations from first principles. After a review of the mathematical and physical structure of the nonrelativistic quantum mechanical three body problem to clarify what physical input is needed, and a review of whether and if so to what accuracy this information is available from two nucleon experiments, existing calculations of the binding energy of the triton ϵ_t and of the n-d doublet and quartet scattering lengths, a_2 and a_4, are reviewed from this point of view. Author (NSA)

N68-31909# California Univ., Livermore. Lawrence Radiation Lab.
BAND PROPERTIES OF EVEN–EVEN NUCLEI WITH SMALL DEFORMATIONS
R. A. Meyer 29 Apr. 1968 28 p refs Presented at the Intern. Symp. on Nucl. Struct., Dubna, USSR, 4–11 Jul. 1968
(Contract W-7405-ENG-48)
(UCRL-71049; CONF-680702-1) CFSTI: HC$3.00/MF$0.65

The gamma ray spectra from the decay of ^{154}Eu, ^{154}Tb, and ^{154}Tb^m have been measured with a maximum energy precision of 40 eV and maximum relative intensity precision of 1% for the more intense gamma rays. Use of a Compton suppression spectrometer allowed detection of low energy gamma rays with a relative intensity of a few parts in 10^6 decays. In addition, coincidence experiments were performed (Ge(Li) spectra gated by signals from a NaI crystal). An attempt was made to describe the level properties of ^{154}Gd obtained from the deduced decay schemes by the Bohr–Mottelson deformed model and its modifications. It is found that the band mixing parameter, z_K, is a poor quantity for this nucleus, and its use for this nucleus in the past may be the cause of a number of discrepancies. Several levels found in this nucleus fit the criteria of forming second vibrational (two-phonon) states. A band which fits the description of a $\beta\gamma$-coupled second vibrational band has been observed. Author (NSA)

N68-31944# Georgia Inst. of Tech., Atlanta. School of Chemistry.
EXPERIMENTAL ASPECTS AND COMPARISONS WITH THEORY OF ORBITAL ELECTRON CAPTURE RATIOS

R. W. Fink [1968] 22 p refs Presented at the Intern. Conf. on Orbital Electron Capture and Higher Order Processes in Nucl. Decay, Debrecen, Hungary, 15–19 Jul. 1968
(Contract AT(40-1)-3346)
(ORO-3346-21; CONF-680703-1) CFSTI: HC$3.00/MF$0.65

Recent improvements in experimental techniques for measurement of M/L and L/K capture ratios are surveyed, and the required accuracy for critical comparisons with theoretical calculations is discussed. Examples of recent investigations which illustrate various improved methods and results are discussed (e.g., ^{37}Ar, ^{40}K, ^{125}I, ^{185}Os, ^{194}Hg). Nuclides of interest for further investigations are suggested, together with discussion of source preparation and suitable experimental methods. A need is indicated for accurate measurements of forbidden electron capture transitions, and for theoretical calculations of the effect of forbiddenness on the Bahcall exchange correction. Current work on forbidden transitions is discussed (e.g., ^{59}Ni, ^{81g}Kr, ^{205}Pb). For second-forbidden nonunique ($\Delta I=2$, no) electron capture transitions (e.g., ^{36}Cl, ^{53}Mn, ^{59}Ni, ^{91g}Nb, ^{63g}Mo, ^{97g}Tc), absolute values of the nuclear matrix elements can be evaluated when both the M/L and L/K ratios and Q_{EC} are known from experiment, as pointed out by Hubbard. Author (NSA)

N68-31951# California Univ., Riverside.
ENERGY SPECTRUM OF π^+ IN $K^+ \rightarrow \pi^+\pi^0\pi^0$ DECAY
D. Davison, R. Bacastow, W. H. Barkas, D. A. Evans, S.-Y. Fung et al Apr. 1968 5 p ref Presented at the Conf. on Exptl. Meson Spectry., Philadelphia, Apr. 1968
(Contract AT(11-1)-34)
(UCR-34-P-107-66; CONF-680428-1) CFSTI: HC$3.00/MF$0.65

The $\pi+$ energy spectrum in $K+\rightarrow\pi++\pi0+\pi0$ decay at rest over the entire energy range 0 t. 52 MeV was studied. For the preliminary analysis the data consists of 1005 tau decays in photographic emulsions in the $\pi+$ energy region 1 to 21 MeV and 1961 events in a heavy liquid bubble chamber in the $\pi+$ energy region 8 to 52 MeV. Absolute decay rates are not measured so the spectrum in each medium is normalized individually. The best fit parameters and probabilities are summarized. NSA

N68-31966# Rome Univ. (Italy). Instituto di Fisica.
RESIDUAL INTERACTIONS IN FINITE NUCLEI: SOME DEVELOPMENTS
C. Boldrighini and A. Tesei 14 Feb. 1968 30 p refs *Its* Note No. 160
(NP-17478)

In the framework of a technique originally proposed by Jean (Nuovo Cimento, 40: 1224(1965)), an exact expression is found for the eigenvalues of several residual interactions in the degenerate model of spherical nuclei. In the nondegenerate model, a general method for numerical calculations is given; in a particular case (small energy gap between the various shells) the first-order correction to the energy matrix is calculated exactly. Author (NSA)

N68-31969# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EQUILIBRIUM DEFORMATIONS OF NUCLEI IN THE RANGE $50<Z<82$, $50<N<82$
D. A. Arseniev, L. A. Malov, V. V. Pashkevich, A. Sobiczewski (Polish Acad. of Sci., Warsaw), and V. G. Soloviev 1968 21 p refs Submitted for publication
(JINR-E4-3816)

The dependence of the energies of the ground states of even–even nuclei on beta and gamma deformations is studied in the range $50<Z<82$, $50<N<82$. The equilibrium deformations and their energies are calculated. It is shown that for nuclei of the region considered, the energy difference between the prolate and oblate shapes of the ellipsoid of rotation is very small, the total nuclear energy having one minimum either for $\gamma=0°$ or for $\gamma=60°$. Author (NSA)

N68-31973# Michigan Univ., Ann Arbor.
THE LEVEL SCHEMES OF Ba 134 AND Tm 171
David Edward Raeside (Ph.D. Thesis) 1968 112 p refs
(Contract AT(11-1)-1112)
(COO-1112-166) CFSTI: HC$3.00/MF$0.65

The gamma-ray spectra associated with the beta decay of ^{134}Cs and the beta decay ^{171}Er were studied with curved-crystal and Ge(Li) spectrometers. The data provide energy and intensity measurements of 11 gamma rays in the ^{134}Cs decay and 38 gamma rays in the ^{171}Er decay. Coincidence measurements were also made. Level schemes for ^{134}Ba and ^{171}Tm are proposed. There is no evidence for the previously proposed levels at 1570 and 1773 keV in ^{134}Ba. Two very weak gamma rays at 243 and 327 keV were measured with the curved-crystal spectrometer and were assigned to the decay of ^{134}Cs. These two transitions can be placed between well established levels in the ^{134}Ba level scheme. No evidence was found for the levels at 489 and 591 keV which other investigators have placed in the ^{171}Tm level scheme. New levels at 862 and 1285 keV are suggested for the ^{171}Tm level scheme. Three new gamma rays which can be placed between well-established levels in ^{171}Tm were measured. The existence of several transitions above 1000 keV in the decay of ^{171}Er was confirmed. Author (NSA)

N68-32053# Murray State Univ., Ky.
KINETIC ENERGY SPECTRA OF FOIL TRANSMITTED FISSION FRAGMENTS OF Cf 252
Shawn Bucy (M.S. Thesis) May 1968 30 p refs
(Contract AT(40-1)-3638)
(ORO-3638-2) CFSTI: HC$3.00/MF$0.65

A mathematical model for the calculation of kinetic energy spectra of fragments from the spontaneous fission of ^{252}Cf has been developed. This model predicts the spectra of these fragments after transmission through any absorber whose thickness and composition are known. The model may be applied to other fissioning elements with minor modifications. Agreement between calculated and experimentally observed peak positions typically agree to within 5%. The energy shifts due to an absorber may be calculated to within 25%. Author (NSA)

N68-32068# National Bureau of Standards, Washington, D. C.
SELECTED TABLES OF ATOMIC SPECTRA. A: ATOMIC ENERGY LEVELS-SECOND EDITION. B: MULTIPLET TABLES. Si I: DATA DERIVED FROM THE ANALYSES OF OPTICAL SPECTRA
Charlotte E. Moore 30 Nov. 1967 11 p refs
(NSRDS-NBS-3; Sec. 2) GPO: HC$0.20; CFSTI: MF$0.65

The present publication is the second section of a series being prepared in response to the increasing demand for a current revision of two sets of tables containing data on atomic spectra as derived from analyses of optical spectra. Both the atomic energy levels and the multiplet table are included in the same publication, as parts A and B, respectively. The Sections are being prepared at irregular intervals for these spectra whose analyses are essentially complete. A flexible paging system permits the arrangement of the various Sections by atomic number regardless of the order in which the spectra are published in this series. Section 1 included three spectra of silicon, Z=14: Si II, Si III, Si IV. The present Section contains similar data for Si I. The form of presentation is described in detail in the text to Section 1, and need not be repeated here. Author

N68-32107# Joint Inst. for Nuclear Research, Dubna (USSR).
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON NON-LOCAL QUANTUM FIELD THEORY

[1967] 229 p refs In ENGLISH and RUSSIAN Symp. held 4–7 Jul. 1967
(JINR-P2-3590)

The following types of nonlocality were considered in the 27 papers presented: different types of form factors, modification of geometry, stochastic space, indefinite metric, Hilbert space, nonlocality following from infinite-dimensional symmetry theory, and the connection of nonlocal and unrenormalizable theories. The role of gravitation and nonlinearity was also discussed. NSA

N68-32130# Tokyo Univ. (Japan). Physics Dept.
THE O(4) SYMMETRY AND THE EFFECTS OF PARTICLE MIXING
Seitaro Nakamura, Hikaru Sato, and Shigeo Sato (Rikkyo Univ.) [1968] 27 p refs
(RUP-68-4)

In terms of the O(4) symmetry, the strong decay of $\phi \rightarrow \rho\pi$, $K\bar{K}$ and the weak decay of $\Sigma \rightarrow \lambda\pi$, $\lambda \rightarrow \pi N$ are studied by taking into account the particle mixing which comes out by the contribution from the symmetry breaking interaction. A selection rule on G'-parity, (parity for the new kind of the extended charge conjugation) is successfully applied for the strong decay of mesons 1^- and 2^+. The observed decay modes of the G'-parity violating transitions are attributed to the effects of the symmetry breaking interaction and the particle mixing. Author

N68-32158# Los Alamos Scientific Lab., N. Mex.
CALCULATION OF THERMAL NEUTRON DIFFUSION LENGTH AND GROUP CROSS SECTIONS: THE GLEN PROGRAM
W. W. Clendenin 10 May 1968 47 p refs
(Contract W-7405-eng-36)
(LA-3893) CFSTI: HC $3.00/MF $0.65

The FORTRAN-IV program GLEN has been developed to obtain thermal neutron scattering cross sections for transport calculations, and to determine the diffusion length for thermalized neutrons. Cross-section values are computed using the results of TOR for a fine mesh of initial and final energies and angles of deflection, and are used to obtain the coefficients in a Legendre polynomial expansion. The total cross section, transport cross section, and similar integral parameters are obtained by numerical integration over the energy mesh. Fine mesh cross sections are used for calculation of the diffusion length, both in diffusion theory and in a P_{11} approximation. Neutron spectra are computed corresponding to an epithermal source and a buckling for thermal neutrons, or optionally a Maxwell distribution is used for the scalar flux. Flux-weighted group cross sections based on these spectra are calculated. The printed results include transfer cross sections and may be used in a few-group Legendre polynomial treatment or in transport calculations based on the S_n method. Card output is provided in the format of cross section input for S_n programs. Author (NSA)

N68-32166 National Research Council of Canada, Ottawa (Ontario).
EFFECTS OF SOURCE THICKNESS IN BETA SPECTROSCOPY [QUELLENDICKENEFFEKTE IN DER BETA-SPEKTROSKOPIE]
I. Hofmann and H. Baier 1968 7 p refs Transl. into ENGLISH from Acta Phys. Austriaca (Wien), v. 20, no. 1–4, 1965 p 53–57
(NRC-TT-1326) CFSTI: $3.00

An overview is presented on the mathematical methods and experimental verification of the effects of source thickness on the beta spectrum of Na^{24}. These involve the use of an intermediate image spectrometer; a standardized momentum spectra; the use of thin foils (an average of 20 to 100 scatters), and electrons with an energy of <1.5 Mev to obtain scattering cross sections; and the application of Monte Carlo calculation methods to boundary value problems. M.G.J.

N68-32178# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.
ELASTIC ELECTRON SCATTERING FROM LIGHT NUCLEI AND NUCLEON-NUCLEON CORRELATIONS
A. Malecki and P. Picchi 24 May 1968 20 p refs
(LNF-68/27) CFSTI: HC $3.00/MF $0.65

A method is presented for calculating the elastic electron scattering form factor for helium 4, in which the short range correlation corrections to the elastic form factor are calculated for nuclei with nucleons in the first s- and p-shells. Numerical results for the helium 4 nucleus are given. To obtain a good fit to the experimental data, the Gaussian wave function describing the relative motion of two nucleons in helium 4 was modified by introducing a repulsive core between nucleons at short relative distances. It is assumed that the internucleon forces at large distances are more attractive then implied by the Gaussian model. M.G.J.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-30901 Rochester Univ., N. Y.
THE DYNAMICS OF LASER INDUCED BREAKDOWN IN GASES
Matt Young (Ph.D. Thesis) 1967 83 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-13657

The breakdown of gases under the influence of a laser beam is analyzed. Classical diffusion theory is taken as a model, with electrons accelerated by inverse bremsstrahlung until they have sufficient energy to ionize neutral gas atoms. Both diffusion and recombination are included as losses. For the rare gases in the range below atmospheric pressure it is found that the relation between the laser pulse duration and the plasma growth time is the primary factor which determines the breakdown threshold. The losses play roles of varying importance depending on gas, pressure and geometry. The initial electrons are generally assumed to have come from multiphoton ionization of impurities, although multiphoton ionization of the gas itself becomes a factor at sufficently low pressures (high photon fluxes). A number of experimental results are presented. These are used to justify some of the theoretical assumptions and to corroborate the results of the theory. Dissert. Abstr.

N68-30905# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
SIMULTANEOUS EXCITATION OF ELECTRON AND ION PLASMA OSCILLATIONS IN PLASMA DIODES
M. Iannuzzi, A. M. Levine, and F. Piperno Feb. 1968 10 p refs Sponsored in part by EURATOM
(LGI-68-5) CFSTI: HC $3.00/MF $0.65

Experimental observation of simultaneous excitation of electron and ion plasma oscillations in a Cs plasma diode is reported. The experimental results are consistent with a recent theory describing the potential distribution in such a diode. Author (ESRO)

N68-30917 Rice Univ., Houston, Tex.
AN EXPERIMENTAL STUDY OF RADIO-FREQUENCY INDUCTION HEATING OF A PARTLY IONIZED MONATOMIC GAS IN A SUPERSONIC FLOW REGIME
William Lee Boddie (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-13055

The hot, partly ionized plasma produced in a D. C. arc-jet was accelerated to supersonic velocities in a deLaval nozzle contoured

so as to exhaust a uniform and parellel stream. The resulting supersonic plasma stream was discharged into a constant area duct made from quartz tubing inclosed within a concentric cooling water jacket. The helical R. F. work coil was wound around the outer tube and connected to the remote unit of a 20 KVA., 4 megacycle power oscillator. The electromagnetic field produced by the R. F. currents flowing in this coil was used to transfer energy to the plasma, which was then further accelerated in a conical nozzle connected to the exit of the R. F. heating duct. The stream from the nozzle flowed into a cylindrical wind tunnel which was connected to the laboratory's vacuum pumping system. The experimental data obtained included the results of a complete calorimetric balance on the heat lost to the seven separate cooling water circuits as well as the electrical inputs to the arc-jet and R. F. oscillator. Dissert. Abstr.

N68-30945 Newark Coll. of Engineering, N. J.
ENERGY TRANSFER AND ELECTRON CONDUCTION IN THE FLUID TRANSPIRATION ARC COLUMN
Pin-Seng Tschang (Ph.D. Thesis) 1967 240 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-14249

The energy relaxation and electrical conductivity of an electron gas in one atmosphere argon arc discharge has been examined theoretically and observed quantitatively in an experimental arrangement. The plasma column utilized for study is the type generated in a fluid transpiration arc equipment in which the argon working fluid is injected through a porous graphite anode. An examination of the various relaxation times in a three-component fluid (electron-ion-neutral) reveals that the self-relaxation times are not negligible compared with the transit times through the nonequilibrium volume. It is therefore proper to employ the usual two-temperature macroscopic model equations obtained from the Boltzmann equation. Accordingly, the electrical conductivity and the two-temperature volume rates of energy transfer have been obtained. The results indicate that while somewhat higher electrical conductivities are observed the volume rates of energy transfer show fairly wide discrepancy between theory and experiment. Dissert. Abstr.

N68-31011 California Univ., Berkeley.
ATOMIC DENSITY MEASUREMENTS IN A DECAYING HIGHLY IONIZED HYDROGEN PLASMA
Peter Russell Forman 1967 76 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-11622

Atomic-density measurements in a decaying, dense, highly ionized hydrogen plasma have been performed by a vacuum UV-absorption technique. Light of wavlength 890.8 Å is shone through the plamsa, and its attention, caused by photoionization of the hydrogen atoms present, is measured. The plasma is formed in a copper cylinder 86.4 cm long with a radius of 7.3 cm. In the interior, the initially highly ionized plasma, which as an ion density of 4.9×10^{15} ions/cc and a temperature of about 1 eV, is found to decay by three-body volume recombination. Its atomic density is observed to increase in time at the correct rate. During the formation of the plasma apparently a layer of atoms is formed near the cylinder wall. This layer has been observed to relax in a time consistent with diffusion inward due to charge-exchange collisions with the ions of the plasma. The energy loss in the interior regions of this plasma is observed to be at a rate considerably in excess of that expected from normal thermal conductivity or even from anomalous diffusion of ions. Dissert. Abstr.

N68-31020# International Centre for Theoretical Physics, Trieste (Italy).
COLLISIONLESS MICROINSTABILITIES IN CONFIGURATIONS WITH PERIODIC MAGNETIC CURVATURE
B. Coppi, G. Laval, R. Pellat, and M. N. Rosenbluth May 1967 45 p refs Presented at the Intern. Symp. on Toroidal Confinement, Princeton Submitted for publication
(IC-66/55) CFSTI: HC $3.00/MF $0.65

In view of investigating the stability of a closed (toroidal) configuration in the high temperature collisionless regime, a one-dimensional model simulating the effects of magnetic curvature variation, magnetic shear, and particle trapping is adopted. Use is made of the Vlasov equation including finite Larmor radius and wave-particle resonance effects. Low frequency electrostatic modes are considered. Then two types of wave having the same periodicity as the magnetic curvature, or localized in a region where curvature is unfavorable, are found. The influence of trapped particles is investigated finding that it contributes to reducing growth rates. Author

N68-31023 California Univ., Berkeley.
QUANTUM MECHANICAL TREATMENT OF STATIC TRANSPORT PHENOMENA IN NON-DEGENERATE PLASMAS
Robert Howell Williams (Ph.D. Thesis) 1967 231 p Available from Univ. Microfilms: HC $10.60/MF $3.00 Order No. 67-11678

A convergent kinetic equation for a non-degenerate electron gas is derived from the quantum mechanical BBGKY hierarchy for the Wigner distribution functions. A technique due to Guernsey is generalized to quantum mechanics. When the two particle interaction is split into a strong, short range part plus a weak long range part, a Boltzmann-like kinetic equation is obtained in which the cross section is a sum of three terms: an exact binary collision cross section for the short range part of the interaction, plus a Born approximation cross section for the dynamically screened long range part of the interaction, plus a cross correlation cross section evaluated in the Born approximation. In the cross correlation term the effects of the long and short range parts of the interaction are mixed. When the limit $\hbar \to 0$ is taken the classical convergent kinetic equation of Guernsey is not obtained, since Guernsey did not consider the cross correlation terms. Dissert. Abstr.

N68-31047 Rice Univ., Houston, Tex.
THE APPLICATION OF RADIO FREQUENCY ELECTROMAGNETIC FIELDS TO HEAT AND CONTROL THE STATE OF A FLOWING PLASMA
Peter James Vermeulen (Ph.D. Thesis) 1967 119 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13134

The argon plasma produced by a DC arc jet was reheated in a cylindrical quartz channel by means of an inductive radio frequency (RF) field. The plasma temperature distribution was studied experimentally and analytically, and was shown to be significantly affected by the RF field. The successful coupling of an RF field to a plasma jet excites immediate interest in that the specific thrust of an electrothermal propulsor can be increased, moreover it may be possible to use the RF "skin effect" to control the temperature distribution to advantage, and hence produce a plasma of more uniform properties. RF reheat applied to arc heated wind tunnels should be beneficial because of increased flow velocity, and a larger test cross section of uniform state. Experiments were conducted at atmospheric pressure and at low subsonic velocities. The temperature distributions of the flow were measured spectroscopically and encouraging evidence of state control in the transition regime was obtained. Dissert. Abstr.

N68-31138 Polytechnic Inst. of Brooklyn, N. Y.
NONLINEAR ASYMPTOTIC ANALYSIS OF THE POSITIVE COLUMN
Herbert Warren Friedman (Ph.D. Thesis) 1967 238 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-13390

The positive column of a slightly ionized gas discharge confined by cold, insulating walls is described by a set of nonlinear continuum equations. Included in this description are the effects of electron and ion inertia, space charge and charged particle-neutral collisions. In the asymptotic limit of small Debye length, the continuum equations separate into two parts, are valid in the quasi-neutral plasma region and the other valid in the space charge sheath. Using the method of matched asymptotic expansions, a zero order solution is derived which is valid throughout the entire cross section of the positive column. The value of potential at the wall is calculated according to a kinetic model and the effects on this potential of a small amount of wall current and reflectivity are investigated. Dissert. Abstr.

N68-31140 California Univ., Los Angeles.
THE EXPANSION AND DIFFUSION OF AN ISOLATED PLASMA COLUMN
Julius Hyman, Jr. (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14308

A new plasma source is described in which a collimated beam of high energy photons generates a plasma in argon by the single-quantum photoionization of the rarefied gas. The photons were generated over a period of 5 microseconds by a vacuum spark driven by a 6 μF capacitor charged to 5 kV. The discharge plasma formed by the spark itself was dissipated by interaction with neutral gas particles and with the beam forming aperture plates before reaching the region in which the photoionization plasma was observed. At 47 cm from the photon source, the density of plasma generation increased from 1.65×10^{11} to 8.22×10^{11} cm^{-3} as the argon pressure pressure was increased from 2.5 to 15 microns, maintaining a nearly constant fractional ionization of 0.16%. Langmuir probe measurements provided a space and time resolved record of the plasma density, plasma potential, and electron temperature. Dissert. Abstr.

N68-31176 Kansas State Univ., Manhattan.
COMPRESSIBLE LAMINAR MAGNETOHYDRODYNAMIC BOUNDARY LAYER FLOW WITH HEAT TRANSFER
Un-Pah Hwang (Ph.D. Thesis) 1967 248 p
Available from Univ. Microfilms: HC $11.25/MF $3.20 Order No. 67-13950

Two-dimensional, steady state, laminar, compressible flow of an electrical conducting fluid across a flat plate and inside a flat duct with a transversely applied magnetic field was studied. The boundary layer equations for the compressible magnetohydrodynamic (MHD) flow are solved by an extension of Morris and Smith's approach to compressible non-MHD flow over a flat plate, which is based on the methods of Kármán–Pohlhausen and Dorodnitsyn. The compressible boundary layer equations including the continuity, momentum, and energy equations are reduced to ordinary differential equations which are solved simultaneously by numerical integration. The effects of compressibility, pressure, and surface temperature gradients on the characteristics of the boundary layer are solved simultaneously without imposing any restrictions on the Prandtl number. A very general form of viscosity variation with respect to temperature is used in the development of the general equations. Dissert. Abstr.

N68-31231# Toulouse Univ. (France).
WAVE PROPAGATION IN PLASMAS [LA PROPAGATION DES ONDES DANS LES PLASMAS]
D. Quemada 1966 120 p refs In FRENCH Presented at the Summer School on Space Phys., Tarbes, France, 19 Aug.–23 Sep. 1966 Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Propagation of plasma waves is studied with the assumption that the plasma is fully ionized and that Coulomb interactions are the main forces (binary collisions are supposed to be negligible). Dielectric tensors and conductivity tensors are defined with the help of a model: the cold plasma model. Thermal plasmas are then envisaged with the help of the Vlasov or the hydrodynamic model. Energy theorems are then computed and applied to a dielectric description of thermal plasmas. ESRO

N68-31274 North Carolina State Coll., Raleigh.
EXPERIMENTAL VERIFICATION OF SELF-FOCUSING IN INTENSE, RELATIVISTIC, ELECTRON BEAMS
Thomas George Roberts (Ph.D. Thesis) 1967 176 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-14922

A self-constricted high current beam of relativistic electrons is produced and its behavior as it propagates through an ionized medium is studied. A 30 nanosecond, 30,000-ampere pulse of 3.5 Mev electrons has been extracted from the electrode space of a pulsed X-ray machine. This beam of relativistic electrons was projected into an ionized medium formed by a conventional linear pitch in argon. This ionized medium has an ion density of the order of 10^{17} per cubic centimeter when the linear pinch has a minimum diameter. The beam of relativistic electrons was allowed to traverse the ionized medium for distances of 9, 18, 24, and 36 inches before being stopped by a target which was one of the electrodes of the linear pinch apparatus. The target material (brass) was such that the damage produced by the relativistic electron beam makes it difficult to determine the actual beam diameter, but this damage does indicate that the total energy of the relativistic electron beam was delivered at the above distances in a manner which is free of any instability that is capable of destroying the beam. Dissert. Abstr.

N68-31286# Japan Atomic Energy Research Inst., Tokyo.
ON THE ELECTRICAL CONDUCTIVITY OF A WEAKLY IONIZED TURBULENT PLASMA
Kyoji Nishikawa Jun. 1968 8 p refs Transl. into ENGLISH from Kakuyugo Kenkyu (Nagoya), v. 16, no. 5, Apr. 1966 p 348–359
(NSJ-TR-122) CFSTI: HC $3.00/MF $0.65

On the basis of the magnetohydrodynamic equations, the effect of density fluctuations on the frequency dependent electrical conductivity of a weakly ionized isothermal plasma is investigated. Only the case in which the magnetic field is static and homogeneous and in which the external electric field is parallel to the magnetic field is considered. The density fluctuations or waves are assumed to be formed by a certain driving force which acts either only on the electrons or only on the ions. The approximations involved are (1) the neglect of the inertia term, (2) the neglect of the mode–mode coupling term except when it acts as a driving force, and (3) the neglect of the response of the driving force to the external electric field. Some special cases are considered in detail. Author

N68-31307# Columbia Univ., New York. Electrical Engineering Dept.
AN APPLICATION OF CORRELATION RADIOMETRY TO THE STUDY OF PLASMA RADIATION
Phillips V. Bradford Mar. 1968 129 p refs *Its* Plasma Lab. Rept. No. 40
(Contract AF 19(628)-5832)
(CU-EE-102; SR-5; AFCRL-68-0168; AD-670844)

Several techniques of correlation radiometry of plasma radiation are developed and described. A method of measuring correlation by the direct interference of two microwave signals is applied to the radiation emitted from the plasma column at frequencies near the electron cyclotron harmonics. Applications for some other techniques in plasma diagnostics are also discussed. Strong correlation is found and measured as a function of magnetic field, gas pressure, and axial separation of two sources, for the enhanced emission from the plasma. This indicated that collective processes

are responsible for the enhanced emission. These processes are identified by the dependence of correlation on the properties of the plasma. The measurements show an unusual dependence on magnetic field and axial separation, which suggests a particular model of the plasma emission processes which can give rise to enhanced emission. The model is discussed. It describes the enhanced radiation as the result of the conversion of slow electro-static waves propagating perpendicular to the magnetic field to fast radiating surface waves propagating along a critical layer in the plasma parallel to the magnetic field. The slow electro-static waves are produced by a beam-plasma interaction. Author (TAB)

N68-31332 Oklahoma Univ., Norman.
AN INVESTIGATION INTO THE STRUCTURE OF ELECTRON FLUID-DYNAMICAL WAVES
George Allen Shelton, Jr. (Ph.D.Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-12006

A one-dimensional, time independent, continuum theory is developed for constant velocity, stable profile, proforce electron fluid-dynamical waves moving into neutral, non-ionized gas. It is shown that the wave profile may be divided into two regions: A thin sheath, located directly behind the front of the wave, in which the electric field falls rapidly to a negligible value and the electrons come to rest relative to the heave particles followed by an extended quasi-neutral, field free region in which ionization continues and the electron fluid cools down. The description of the thin sheath layer results in a dynamical theory of Debye layers. Wave speed and degree of ionization resulting from a given wave are determined as functions of applied electric field and initial pressure using a proposed equation. For helium at an initial pressure of 1 torr at 0°C, it is found that a typical wave of speed $V = 10^9$ cm/sec results from an appled electric field of 5.52×10^4 V/m. The electron density resulting from such a wave is 3.91×10^9 cm^{-3}. It is anticipated that the approach employed may be extended to antiforce waves, more complex geometries, and to time dependent cases. Dissert. Abstr.

N68-31394# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Avionics Lab.
CONCENTRATIONS OF Au ATOMS IN HOLLOW-CATHODE DISCHARGE BY RESONANCE-LINE ABSORPTION
W. C. Kreye Mar. 1968 14 p refs Presented at the 8th Intern. Conf. on Phenomena in Ionized Gases, Vienna, 27 Aug.–2 Sep. 1967
(AFAL-TR-67-346; AD-670596)

The determination of the concentration of sputtered gold atoms in a hollow-cathode discharge at approximately 450 mtorr of argon was made by measuring the absorption of the two resonance lines, 2428 and 2676A, of a gold hollow-cathode source. The following points are considered: effect of fluctuation in source discharge is minimized by employing double-beam reflective optics, and the continuum is accounted for by measuring separately its intensity at a monochromator setting about 4A from the position where absorption is at a maximum. Self-absorption is minimized by extrapolating the absorption-vs-source current curves; the radiation from the DC absorber discharge is eliminated by chopping the source and using a phase-sensitive detector. Taking into account the variation of the absorption coefficient with wavelength, derived relations between measured absorption and the peak absorption coefficient, ko, are employed to calculate ko for different absorber discharge currents. The average of the ratio of ko at 2428A to ko at 2676A is calculated to be 2 plus or minus 0.2, agreeing well with the literature value of 2.1 for the ratio of oscillator strengths. If the widths of the emission line and the absorption coefficient are assumed to be purely Doppler corresponding to a measured discharge temperature of 355K, the concentration of gold atoms can be calculated and is presented. Author (TAB)

N68-31430# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
PERIODIC PULLING AND THE TRANSITION TO TURBULENCE IN A SYSTEM WITH DISCRETE MODES
Herbert Lashinsky Apr. 1968 41 p refs Presented at the Symp. on Turbulence of Fluids and Plasmas, New York, 16–18 Apr. 1968 Submitted for publication
(BN-542)

Consideration is given to experiments with thermal plasma devices in which the discrete mode spectrum gives rise to a continuous noise spectrum, characteristic of turbulence, that implies the introduction of new degrees of freedom. A nonlinear mechanism is described by means of which the transition from the discrete mode spectrum to low-level turbulence can be accomplished in a system characterized by a modest number of modes. The mechanism provides a means for modulation of the characteristic frequency and amplitude of the discrete-mode, thus generating sidebands that eventually broaden the discrete mode frequencies until a continuous spectrum is produced. This mechanism of periodic pulling is based on a model in which the modes are treated as an ensemble of van der Pol oscillators that are weakly coupled by the nonlinearity of the plasma medium. Experimental results obtained in a Q machine are described and compared with the theory. Analog experiments, carried with conventional audio oscillators, are also described. B.S.D.

N68-31436*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics.
STRUCTURE OF MAGNETOHYDRODYNAMIC SHOCK WAVE
Chung Kung Liu Jun. 1967 65 p refs
(Grant NGR-09-005-025)
(NASA-CR-95956; Rept.-67-028) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The structure of the plane magnetohydrodynamic shock wave of a rarefied, fully-ionized plasma was studied. Both the shock front and the magnetic field were assumed to be perpendicular to the flow direction. In the undisturbed region, the gas pressure ($=nkT$) can be comparable to, much smaller or much larger than the magnetic pressure ($=B^2/8\pi$), and also the magnetohydrodynamic Mach number (M^*) can be any value greater than unity. Since the plasma is so rarefied that the mean free path here cannot be considered as a relevant scale length for the shock thickness, instead the geometrical mean of the ion and electron Larmor radius is the appropriate one. Under these assumptions, the structure of large M^* shock wave is solitary wave-like, and that of the smaller M^* shock waves can be either oscillatory or monotonic depending on the value of electrical resistivity. Author

N68-31443# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
SOME SIMILARITY TRANSFORMATIONS IN MAGNETOGAS-DYNAMICS
Ferdinand Cap and Dietmar Floriani 30 Mar. 1968 28 p refs
(Contract F61052-67-C-0014)
(SR-53; AFOSR-68-1187; AD-670526)

In order to get similarity solutions of some problems of magnetogasdynamics the mechanism of similarity transformations is applied to the corresponding equations. Five cases are treated: three two-dimensional boundary layer theory cases (1) magnetic field perpendicular to the flow, unsteady case, (2) the same, but steady, (3) the steady problem with arbitrary magnetic field; a three-dimensional boundary layer problem, also with arbitrary magnetic field; and, without boundary layer approximation, the general three-dimensional unsteady MGD-equations. Author (TAB)

N68-31460# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF THE WIDENING AND SHIFT OF THE SPECTRAL LINES OF CESIUM FOR DETERMINING THE CONCENTRATION OF CHARGED PARTICLES AND NEUTRAL ATOMS IN THE PLASMA OF A dc ARC [ISPOL'ZOVANIYE USHIRENIYA I SMESHCHENIYA APEKTRAL'NYKH LINIY TSERIYA DLYA OPREDELENIYA KONTSENTRATSII ZARYAZHENNYKH CHASTITS I NEYTRAL'NYKH ATOMOV V USLOVIYAKH PLAZMY DUGI POSTOYANNOGO TOKA]
L. I. Grechikhin and D. K. Skutov 13 Jun. 1967 19 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 4, no. 5, 1966 p 381–388
(FTD-HT-66-649; AD-670895)

A refined computation of the Stark constants was made. The limits of the measurement of the concentration of charged particles along different, experimental contours were obtained for a number of spectral lines of the atoms of cesium. A calculation was made of the charged particles and neutral atoms in the plasma of a DC arc. The results of the simultaneous measurement of the concentration of charged particles and neutral atoms of cesium in the plasma of the DC arc are presented. The concentration of charged particles measured in such a way relates to zones of discharge close to the center, where basically the widening of the lines occurs. The error in the measurement of the concentration of the neutral atoms is approx. 50%. In this way all the methods used for determining the concentration of the charged particles in the DC arc give results that agree. Author (TAB)

N68-31486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME VARIATIONAL PROBLEMS ON THE ACCELERATION OF CARRIER GAS IN STRONG ELECTROMAGNETIC FIELDS [NEKOTORYYE VARIATSIONNYYE ZADACHI OB USKORENII PROVODYASHCHEGO GAZA V SIL'NYKH ELEKTROMAGNITNYKH POLYAKH]
G. M. Bam-Zelikovich 9 Jun. 1967 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow), no. 3, 1964 p 9–15
(FTD-HT-66-761; AD-670918)

Two specific problems are posed and solved with respect to the maximum efficiency of plasma acceleration in crossed magnetic and electrical fields when electromagnetic forces are much greater than the forces of pressure. The first problem is to determine that distribution of channel cross sectional area, potential difference and intensity of external magnetic field along the channel length which will produce the maximum plasma velocity for a fixed channel length. The second problem is to determine values of s(x), h(x) and phi(x) assuring minimal losses due to Joule dissipation, assuming that the plasma must be accelerated from v sub zero to v sub 1 over an assigned channel length. Author (TAB)

N68-31585# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
EFFECT OF DISTURBANCES IN THE LANGMUIR LAYER OF CATHODE ON THE IONIZATION RATE IN ARC DISCHARGE ... [VLIYANIE VOZMUSHCHENII V LENGMYUROVSKOM SLOE U KATODA SKOROST IONIZATSII V DUGOVOM RAZRYADE]
I. P. Stakhanov 1967 23 p refs In RUSSIAN
(FEI-96)

The results of several studies of nonequilibrium ionization in low-voltage arcs are summarized. A statement of the problem is presented and formulas of ionization rate in various instances are derived. The number of ionization rate in various instances are derived. The number of ions arising in the inter-electrode gap owing to nonequilibrium ionization is estimated, as is the width of the region within which this ionization occurs. NSA

N68-31615# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTABILITY OF DISCHARGE WITH INCANDESCENT CATHODE IN A MAGNETIC FIELD AT LOW PRESSURES [NEYSTOYCHIVOST' RAZRYADA S NAKALENNYM KATODOM V MAGNITNOM POLE PRI NIZKIKH LAVLENIYAKH]
M. A. Vlasov, Ye. I. Dobrokhotov, and A. V. Zharinov 30 Jun. 1967 48 p refs Transl. into ENGLISH from Dokl. Inst. At. Energii (Moscow), no. 790, 1964 p 1–43
(FTD-MT-66-110; AD-670960)

The results of an investigation of gas discharge with an incandescent cathode in an equipotential volume in magnetic field with intensity up to 2000 oe are given. In the investigated range of pressures, from 0.000002 to 0.0001 mm Hg, a plasma column will be formed which is negatively charged relative to the surrounding walls. It is established that such a discharge becomes unstable with an increase in the pressure of the neutral gas. There was formed a plasma jet, steadily revolving to the electron side, which breaks away from the region of the primary beam. The appearance of the jet is the result of polarization of plasma in the beam of primary electrons in the presence of azimuthal heterogeneity in density and distinction in the drift speeds of ions and electrons. With a further increase in pressure steady-state rotation vanishes and intense oscillations with continuous spectrum of frequencies are developed in the discharge. An explanation of the basic regularities of behavior of discharge is given. On the basis of a simplified model an expression for the frequency of rotation of the jet is obtained; it is qualitatively confirmed by an experiment. Author (TAB)

N68-31621# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
DISTRIBUTION FUNCTION OF FAST ELECTRONS AT THE BOUNDARY WITH THE ELECTRODE [FUNKTSIYA RASPREDELENIYA BYSTRYKH ELEKTRONOV NA GRANITSE S ELEKTRODOM]
I. P. Stakhanov and P. P. Shcherbinin 1967 16 p refs In RUSSIAN
(FEI-106)

The kinetic equation is solved for fast electrons and the electron distribution function is investigated in the neighborhood of a nonemitting electrode. The electron flux across the potential barrier (for a given plasma density) and the extrapolated length for electrons are elucidated. NSA

N68-31633*# Volt Technical Corp., Washington, D. C.
STUDY OF THE POSSIBILITY OF AMPLIFICATION OF A VERY RELATIVISTIC SYNCHROTRON OR GYROMAGNETIC RADIATION BY A NONCOLLECTIVE PLASMA
M. J. Heyvaerts 12 Aug. 1968 19 p refs Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 31, no. 1, 1968 p 129–139
(Contract NAS5-12487)
(NASA-CR-96124; ST-PP-10737) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An analysis is made of the possibilities of amplification of synchrotron radiation taking into account the detailed form of the radiation pattern; collective effects are neglected. While amplification is never possible in one polarization, it may occur in another in the presence of particle beams with angular spread of the order of the radiation pattern's aperture angle. Author

N68-31640*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EMITTER AND COLLECTOR SHEATHS FOR CESIUM THERMIONIC DIODES WITH POLYCRYSTALLINE TUNGSTEN ELECTRODES

James F. Morris Washington Aug. 1968 13 p refs
(NASA-TN-D-4744) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Using electrode temperatures above and below those of thermally ionized plasmas, this analysis estimates sheath properties for polycrystalline tungsten emitters and collectors in cesium thermionic diodes. The fields of these positive ion sheaths modify particle emissions from the plane electrodes; the sheath voltages affect cesium arrival, hence contact ionization rates. Cesium coverage dictates the work function, which is 4.59 volts for a bare electrode. In this study the assigned temperatures run from 1600 to 2400 K for plasmas with 10^{12} and 10^{13} electrons per cubic centimeter. Tabulations give results for diodes putting out from 0 to 1 ampere per square centimeter. Graphic trends of electrode and sheath characteristics also appear. The analysis applies to equilibria and near-equilibria. Author

N68-31667# Atomics International, Canoga Park, Calif.
ON THE EFFICIENCY OF MHD PROCESSES WITH INJECTION CONDENSATION
W. Oldekop and D. Rex [1967] 30 p refs Transl. into ENGLISH from Advan. Energy Convers., v. 7, 1967 p 137–157
(AI-TRANS-263)

Thermodynamic cycles with multistage injection condensation, which have been suggested for the supple of fast flowing liquid to liquid-metal MHD generators, are subjected to a critical calculation. A mathematical treatment of the multistage process is developed, by which any path for the process can be calculated with steady functions. This gives the possibility of varying the type of process path, as well as the start and end point of the process, by aid of a computer, in order to find the maximum possible efficiency. This maximum, $\eta = 5.35\%$, obtained from a whole of 36 different paths, is only slightly better than the efficiency of the single-stage injection condenser. Assuming a conversion efficiency of the MHD generator of 70%, the overall efficiency is only about 3 to 5%. The use of recuperative heat exchangers could be advantageous and should be theoretically treated. Author (NSA)

N68-31682# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ON THE METHOD FOR THE NUMERICAL SOLUTION OF A SYSTEM OF DISPERSIVE DIFFERENTIAL EQUATIONS
Akizi Outi May 1968 48 p refs
(IPPJ-68) CFSTI: HC $3.00/MF $0.65

A system of dispersive nonlinear partial differential equations which is capable of analytic solutions is solved numerically by the use of several different finite difference methods; each result is compared with the analytic solution. The central difference scheme is found to be excellent in simplicity and accuracy. But a kind of error peculiar to this scheme is found. The properties of the errors are studied by example and methods to suppress such errors are proposed. The necessity of the conservative form is also referred to. Author

N68-31718# Los Alamos Scientific Lab., N. Mex.
TRANSMISSION AND EMISSION OF RADIATION BY A MAGNETIZED LABORATORY PLASMA
Harry Dreicer [1968] 50 p refs Presented at the NATO Advanced Study Inst. on Plasma Waves in Space and in the Lab., Roeros, Norway, 17–26 Apr. 1968
(Contract W-7405-ENG-36)
(LA-DC-9540) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical comparisons were made for data on the transmission and emission of radiations from magneto-plasma. NSA

N68-31754# American Science and Engineering, Inc., Cambridge, Mass.
ON THE EXISTENCE OF SOLUTIONS TO CERTAIN SHOCK-WAVE MODELS Final Report, 14 Oct. 1966–15 Oct. 1967
Yvain M. Treve 27 Mar. 1968 55 p refs
(Contract F19628-67-C-0057)
(ASE-1892; FR-1; AFCRL-68-0222; AD-670588)

The differential equations of two models for the profile of a steady and plane shock wave in a gaseous medium are studied. The first model deals with the case of a neutral gas. It is shown that it possesses an infinity of solutions depending upon two arbitrary parameters. In the second model, the medium is a fully ionized hydrogen plasma. The only positive result obtained is that the topological nature of the relevant singular points in the differential equations allows for the existence of a solution. Whether a solution does exist and is unique is a difficult problem whose solution will require more work, both theoretical and numerical. Author (TAB)

N68-31780# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSVERSE EDGE EFFECT IN INDUCTION PUMPS [K VOPROSU O POPERECHNOM KRAYEVOM EFFEKTE V INDUKTSIONNYKH NASOSAKH]
L. Ya. Ulmanis 24 Jul. 1967 13 p refs Transl. into ENGLISH from Vopr. Magnitn. Gidrodinam. i Dinam. Plazmy (Riga), 1962 p 561–567
(FTD-HT-67-472; AD-671140)

Experimental investigations of the transverse edge effect in induction pumps were carried out on metallic plates in the channel of a mercury pump at a flow rate Q = 0. The following formula was derived for determining the coefficient of K sub delta which characterizes the transverse edge effect: K sub delta = 1 + C (tau/alpha) to the 2nd power, where tau is the pole spacing of the pump; alpha is the width of the metal layer in the pump throat, C is a constant (C nearly equal to 1). TAB

N68-31787# Stanford Univ., Calif. Inst. for Plasma Research.
EXPERIMENTAL ELECTRODE CURRENT DISTRIBUTIONS IN MHD CHANNELS
J. L. Kurz Apr. 1968 127 p refs
(Contract AF 49(638)-1695)
(SU-IPR-230; AFOSR-68-1298; AD-670527)

The distribution of current on the electrodes of a single-pair MHD channel was investigated experimentally. The experiments were performed with a flowing, atmospheric-pressure, alkali-metal-seeded argon plasma at temperatures between 1980K and 2150K for Hall parameter values up to seven. Two electrode configurations were investigated; one with the electrodes projecting into the flowing plasma, the other with the electrodes flush with the channel wall. Qualification measurements showed that the plasma free-stream conditions were uniform across the channel and in agreement with equilibrium calculations. Results for the anode current distribution were in all cases in good agreement with the theoretical predictions. The cathode current distribution was found to agree less well with the predictions. It was observed that the cathode current distribution for flush electrodes was considerably more uniform than for projecting electrodes. The anode voltage drop was consistently a small fraction of the total applied voltage for both electrode configurations. In contrast, the cathode voltage drop for the flush electrode channel was about four times that for the projecting electrode channel and constituted nearly 50 per cent of the total applied voltage. The cathode voltage drop was found to correlate reasonably well with the Schottky equation. Measurements made of the root-mean-square voltage fluctuations between voltage probes were consistent with the presence of magnetoacoustic and electrothermal waves. Author (TAB)

N68-31798# Rydbeck Research Associates, Fjaras (Sweden).
REFLECTION AND AMPLIFICATION OF ELECTROMAGNETIC WAVES IN AN OSCILLATING IONIZED MEDIUM, PART 2

J. Askne Dec. 1967 63 p refs
(Contract AF 61(052)-864)
(SR-10; AFCRL-68-0313; AD-670559)

An investigation of the scattering of a plane wave incident upon a time-space periodically-modulated dispersive medium is presented. The ambiguity associated with Floquets theorem is resolved and also a generalization of Braggs law is given to include moving scatterers. The interpretation of the Brillouin diagrams is extended in order to take the self-consistent modes into account. It is demonstrated that the dispersion yields possibilities to four types of interaction which leads to evanescent waves, simple propagating waves, growing waves, and also to an absolute instability. A rigorous solution, including all the self-consistent modes, and the corresponding infinite number of time-space harmonics is given. Computer results are presented and demonstrated to accord very well with the more practical coupled-mode analysis. Author (TAB)

N68-31819 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THEORY OF POPULATION OF EXCITED LEVELS OF ATOMS AND IONS AND ITS APPLICATION TO DETERMINATION OF ELECTRON TEMPERATURE AND DENSITY FROM RELATIVE LINE INTENSITIES OF THE IONS C_4, N_5, AND O_5 [TEORIA OBSADZENIA POZIOMOW WZBUDZONYCH ATOMOW I JONOW I JEJ ZASTOSOWANIE DLA OKRESLENIA TEMPERATURY I GESTOSCI ELEKTRONOW ZE WZGLEDNYCH NATEZEN LINII JONOW C_4, N_5, I O_5]
Szymon Suckewer 1967 67 p refs
(Rept.-859/XVIII/PP) CFSTI: $3.00

The theory of population of excited levels for atoms and ions is given for stationary, non-thermal plasmas. Simplified expressions were obtained, with the aid of which populations of the levels 2P, 3P, and 3D were determined for the ions C_4, N_5, and O_5. It is shown that the populsions obtained by this method are in a very good agreement with the populations determined directly from the balance of excitation and de-excitation processes. The plots are given, which enable the determination of electron density and temperature from relative intensities of 3 chosen lines from a given ion. Author

N68-31845*# Mount Auburn Research Associates, Inc., Cambridge, Mass.
THEORY OF THE CIRCULAR PLANAR (GUARDRING) LANGMUIR PROBE
Lee W. Parker 12 Apr. 1968 85 p refs
(Contract NAS5-9088)
(NASA-CR-96155) CFSTI: HC$3.00/MF$0.65 CSCL 20I

A computational study is presented of the properties of a guardring-type circular planar Langmuir probe, commonly flush-mounted in the skin of a satellite. This geometry results in a three-dimensional potential distribution which cannot be treated analytically, even in axially symmetric problems. Given arbitrary particle velocity distributions at infinity, the current–voltage characteristics of the external aperture grid and of an internal repelling collector may be determined by particle trajectory calculations. The electric field and charge density distributions in the vicinity of the probe are defined at the nodes of a grid. The charge density and collected currents in the Poisson equation are evaluted by summing trajectory contributions. The Poisson field is computed self-consistently by an iterative technique. Two kinds of particle velocity distribution are considered: a streaming Maxwellian at infinity, and photoelectric emission at the satellite surface. An infinite-satellite model is assumed for the Poisson case (Debye length = 1 cm). For the Laplace case (Debye length infinite), the effects of finite satellite dimensions, of Mach streaming at an angle, and of photoelectrons are investigated. Author

N68-31898# Stevens Inst. of Tech., Hoboken, N. J.
Q-MACHINE PLASMA CAMERA
William Wallace Destler (B.S. Thesis) [1968] 36 p refs
(Contract AT(30-1)-2813)
(SIT-2813-45) CFSTI: HC$3.00/MF$0.65

A device to determine the spatial distribution of a magnetically confined, quiescent potassium plasma was constructed following the basic design of Sinel'nikov, et al. Initial results at low plasma number density (10^9 to 10^{10} cm^{-3}) confirm Langmuir probe measurements and add substantially to the knowledge of the instantaneous asymmetry of the plasma at points along the plasma column. Results at higher plasma density are expected to yield better resolution and more information on the relation of asymmetry to plasma instability. Author (NSA)

N68-31903*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS AND APPLICATION OF THE DIELECTRIC CONSTANT OF A TWO-TEMPERATURE PLASMA
E. H. Klevans and J. R. Primack 1 Feb. 1967 41 p refs
(Contract NAS7-100)
(NASA-CR-95990; JPL-TR-32-888) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A discussion is presented of three problems which arise in the study of fully ionized plasmas where the electron temperature exceeds the ion temperature. In the first problem, the dielectric constant of a two temperature plasma is analyzed to determine (1) the conditions under which ion waves will be found, (2) accurate values for the phase velocity and damping rate of ion waves, (3) the validity of approximate expressions for the ion wave phase velocity and damping, and (4) the behavior of the dynamic shielding factor when ion waves are possible. The second problem concerns the numerical evaluation of the high-frequency conductivity of a two temperature plasma. Approximations, and their validity, are discussed. Results are presented for the real part of the conductivity as a function of frequency with the electron-to-ion temperature ratio as a parameter. For the third problem, the electrostatic energy per degree of freedom is computed. A comparison is made of numerical results obtained from approximate analytic expressions with those obtained from numerical integration of the exact expression. Author

N68-31928# Avco-Everett Research Lab., Everett, Mass.
ELEVENTH AFOSR CONTRACTORS' MEETING ON NON-CHEMICAL ENERGETICS: SUMMARIES OF RESEARCH
G. S. Janes [1968] 41 p refs Meeting Held in Boston, 20-22 May 1968
(Contract AF 49(628)-1553)
(AFOSR-68-1377; AD-671149)

Subjects reported include plasma diagnostics, magnetohydrodynamics acceleration and power generation, high temperature plasma production and containment related to controlled fusion, and charged particle accelerators related to physical energetics processes in energy and power sources and conversion. Research principal investigators and their affiliations are identified. Author (TAB)

N68-31934# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.
AN EXPERIMENTAL DETERMINATION OF THE DYNAMIC VISCOSITY OF ATMOSPHERIC ARGON FROM 3500 TO 8500 DEGREES KELVIN
Daniel P. Aeschliman Mar. 1968 200 p refs
(Contract AF 49(638)-1533)
(NU-GDL-8-1-1533; AFOSR-68-1210; AD-670530)

A direct-current wall-stabilized arc, constrained to the axis of a precision-bore Vycor tube, was employed for the determination of the dynamic viscosity mu (T sub g) of argon at atmospheric pressure over the heavy-particle temperature range 3500 < or =

T sub g < or = 8500K. It was found that except for a slightly elevated electron temperature, the arc could be expected to operate in local thermal equilibrium (LTE) along the arc axis. Spectroscopic measurements gave an electron temperature of 9300K along the axis. Allowing for kinetic non-equilibrium, the heavy-particle temperature along the axis was calculated to be 9020 plus or minus 150K. The T sub g(r) profile was found to be consistent with other arc parameters which could be measured experimentally, in particular, the total mass flow and the total arc current. Author (TAB)

N68-31988*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.

AN INVESTIGATION OF MICROWAVE INTERACTION WITH A PLASMA CONFINED IN A DIPOLAR MAGNETIC FIELD

T. G. Twardeck 30 Jul. 1968 113 p refs
(Grant NsG-134)
(NASA-CR-98142; SR-320) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An investigation of the properties of a plasma confined in the dipolar magnetic field of a uniformly magnetized sphere has been conducted. The main laboratory diagnostic tools were microwave interferometers operating at 3.0, 1.34 and 0.86 cm. Laboratory measurements included changes in received power and phase for various plasma densities, scattering angles and frequencies, and changes in the received power for different pressures in the vacuum vessel, plasma densities and frequencies. An idealized model of the scattering geometry is presented and expressions for the scattering coefficients and scattered field quantities are formulated in terms of the plasma parameters. The digital computer techniques for evaluating the appropriate expressions are described and the influence of each physical paramerer on the calculations is considered. The comparison of the simple theoretical model with experimental results indicates that in forward scattering angles the plasma is accurately described as a plasma shell characterized by a constant complex refractive index for the plasma densities, collision frequencies and incident wave frequencies encountered in the laboratory investigation. Author

N68-32050# Oak Ridge National Lab., Tenn. Health Physics Div.

NONLINEAR INTERACTIONS IN QUANTUM PLASMAS

R. E. Wilems (Ph.D. Thesis—Tenn. Univ.) and R. H. Ritchie Jun. 1968 166 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2101) CFSTI: HC $3.00/MF $0.65

Interactions of photons and fast electrons with plasmons in both bounded and unbounded systems are investigated within the framework of a quantum hydrodynamic model for the plasma. Plasmons in both perfect plasmas and plasmas containing structural imperfections are studied. Among the several interactions of photons with perfect plasmas which are examined are radiative damping of plasmons, resonance fluorescent scatter, second harmonic generation, and Raman scatter. The frequency shift of the radiative surface plasmon due to coupling with the radiation field is investigated, and resonance emission from photon-stimulated plasmons in imperfect plasmas and "grating" plasmas is also explored. Characteristic energy loss and gain by fast electrons through interaction with the plasmon field are studied. In addition, energy exchange through the plasmon field between various combinations of electrons and photons is examined. The process of "Auger" electron emission from a semi-infinite plasma through the deexcitation of electron-excited surface plasmons is also investigated. Author (NSA)

N68-32054

RECOMBINATION RADIATION AND BREMSSTRAHLUNG OF ELECTRONS IN A FIELD OF O II AND N II IONS

S. G. Grenishin, L. S. Nikolaevskii, and S. F. Simonenko [1968] 5 p refs Transl. into ENGLISH from Zh. Prikl. Spectry. (USSR) v. 8, no. 5, 1968 p 803-806
CFSTI: HC $3.00/MF $0.65

The absolute radiativity values of nitrogen, oxygen, and air plasmas were measured by the photographic method of comparing the spectral brightness of the investigated and etalon light sources in the 700 to 250 nm band. A column of hot hydrogen or helium plasma, excited in a direct punch-through discharge tube by a powerful current pulse, was used as the source. The electron brehmsstrahlung and recombination radiation in the field of H+, He+, and He^{2+} atomic ions were computed theoretically. It is pointed out that the measured value of the N_2, O_2, and air radiativities provide experimental data for confirming existing theories on the continuous spectra of complex atoms, and for determining the charged particle intensity by means of the background intensity. Hydrogen and helium plasma radiation were computed by formulas obtained from the absorption coefficient of an electron passing from the bound into the free state in the field of an atomic nucleus with charge Z_e. The quantum mechanical solution of the same problem yields a result diverging from the classical by not more than 15%. Author

N68-32069*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

QUANTUM THEORY OF AN ELECTRON GAS WITH ANOMALOUS MAGNETIC MOMENTS IN INTENSE MAGNETIC FIELDS

Hong-Yee Chiu, Vittorio Canuto, and Laura Fassio-Gunuto (C.I.E.A., Mexico) [1968] 18 p refs
(NASA-TM-X-61035) CFSTI: HC $3.00/MF $0.65 CSCL 20I

In this paper we have continued our investigation of the properties of an electron gas in intense magnetic fields. We have obtained expressions for the thermodynamic energy density particle density, the magnetic moment, and pair density (created in equilibrium with the system) for a gas of electrons with an anomalous magnetic moment, using the exact eigenvalues of the Dirac-Pauli equation for an electron with an anomalous magnetic moment, obtained by Ternov. According to the solution of Ternov, the lowest energy states of the electrons can be zero at certain field strengths. We have shown that pair creation does not occur spontaneously at the expense of thermodynamic energy of other particles of the system. Exact expressions for the pair density is given. Author

N68-32072*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANOMALOUS DIFFUSION IN A PLASMA FORMED FROM THE EXHAUST BEAM OF AN ELECTRON-BOMBARDMENT ION THRUSTER

Allan J. Cohen Washington Aug. 1968 30 p refs
(NASA-TN-D-4758) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A 10-cm-diam. cylindrical anode with a grounded coaxial center rod was immersed in the low density ($n_e \approx 2 \times 10^7$ cm^{-3}) exhaust beam of an ion thruster. A longitudinal magnetic field was applied. A theoretical and experimental study was made of the electron diffusion process in the beam plasma passing through the electrically floating anode. Anomalous diffusion and low frequency noise wer found. The mechanism of anomalous diffusion was considered similar to that reported by Kadomtsev and Nedospasov. Bohm's diffusion equation was found applicable and a constant of 1/8 (twice Bohm's value) was deduced experimentally. Rotation in the plasma was found by means of a correlation technique. The measured frequency of rotation ranged from 100 to 150 kHz. Author

N68-32090# Oak Ridge National Lab., Tenn. Thermonuclear Div.
THERMONUCLEAR DIVISION Semiannual Progress Report, Period Ending 31 Oct. 1967
May 1968 161 p refs
(Contract W-7405-ENG-26)
(ORNL-4238) CFSTI: HC $3.00/MF $0.65

Progress reports are presented on various thermonuclear research projects. Summary information is given on studies concerned with (1) high-current ion beam production and injection, (2) electron-cyclotron heating, (3) plasma theory and computation, (4) magnetics and superconductivity, and (5) plasma physics. Neutral injection experiments in the DCX-1.5 facility are discussed along with multiple-pass experiments in the DCX-2 facility. B.S.D.

N68-32105*# Catholic Univ. of America, Washington, D. C. Space Science and Applied Physics Dept.
THE ROSENBLUTH–FERRARO–DUNGEY SHEATH
Charles Buffalano Jul. 1968 27 p refs
(Grant NGR-09-005-025)
(NASA-CR-96153; Rept.-68-006) CFSTI: HC $3.00/MF $0.65
CSCL 20I

A critical evaluation is presented on the Rosenbluth–Ferraro–Dungey sheath, which is a simplified model of the transition region between a cold, collisionless, streaming plasma and a vacuum magnetic field. The conclusion is drawn that the sheath is probably a poor microscopic model of the plasma–vacuum interfaces, and that the extraneous electric and magnetic fields required by consistent solutions of the general sheath equations introduce conceptual difficulties which are unavoidable for arbitrary directions of the incident plasma. The success of the model is attributed to the fact that the sheath characteristics modeled have been independent of the detail. M.G.J.

N68-32168# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SPECTROSCOPIC MEASUREMENTS OF TEMPERATURE IN INDUCTION PLASMA TORCH [SPEKTRALNE POMIARY TEMPERATURY PLAZMY W PLAZMOTRONIE INDUKCYJNYM]
J. Lesinski, B. Lewandowski, and S. Suckewer 1968 20 p refs In POLISH; ENGLISH summary
(IBJ-906/18/PP) CFSTI: $3.00

Temperature and electron density distribution in an induction argon plasma torch were studied. Nominal output of the supplying RF generator was 10 kW and frequency was 3 MHz. Plasma temperature was determined from the absolute intensity of argon atomic lines and from the absolute intensity of continuum radiation. Author

N68-32175 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. 3. RESULTS OF EXPERIMENTAL STUDIES [BADANIA NAD WYTWARZANIEM I OGRANICZANIEM PLAZMY W UKLADZIE SFERYCZNEGO MULTIPOLA MAGNETYCZNEGO. 3. WYNIKI BADAN EKSPERYMENTALNYCH]
Marek Sadowski 1968 51 p refs In POLISH; ENGLISH summary
(IBJ-914/18/PP)

Part III of the paper presents the results of experimental research on the production and containment of hot plasma in a spherical multipole magnetic field. Investigations of the synchronous operation of 6 fast gas valves and 6 plasma injectors are described. The lifetime of the plasma is assessed on the basis of integral visible radiation. For comparison with the above lifetime, measurements performed in the conventional cusped geometry, and in a hybrid SM-trap with an additional mirror field are described. Results of probe measurements of the plasma lifetime in the traps investigated are given. The investigations referred to prove that the plasma lifetime in the SM-type trap (under conditions of the experiment—85 μsec) is approximately 3 times that in the cusp configuration, with the other experimental conditions identical. Author

N68-32182# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. 1: THE CONCEPT AND EXPERIMENTAL PROGRAM [BADANIA NAD WYTWARZANIEM I OGRANICZANIEM PLAZMY W UKLADZIE SFERYCZNEGO MULTIPOLA MAGNETYCZNEGO. 1: KONCEPCJA I PROGRAM EKSPERYMENTU]
Marek Sadowski 1968 40 p refs In POLISH; ENGLISH summary
(IBJ-912/18/PP) CFSTI: $3.00

Part I of the paper presents conditions to be fulfilled for effective hot plasma containment. Comparison of different magnetic traps is given, and the concept of plasma confinement involving a spherical multipole magnetic field is discussed. The "Kaktus" research project is described, and comparison of the geometry or different spherical multipoles is given. Results of investigations of a selected variant of the containment field are also presented. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-30879# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
INTERACTIONS BETWEEN IMPURITIES AND DEFECTS CREATED BY IRRADIATION IN IRON [INTERACTIONS ENTRE LES IMPURETES ET LES DEFAUTS CREES PAR IRRADIATION DANS LE FER]
Pierre Vigier (Ph.D Thesis) Jan. 1968 116 p refs In FRENCH; ENGLISH summary
(CEA-R-3280) CFSTI: HC $3.00/MF $0.65

Chapter 1 is a brief review of the most important properties of point defects; the author is particularly interested in radiation damage; the different models proposed until now to explain the five annealing stages are exposed. Chapter 2 describes the experimental processes insisting on how fruitful the magnetic after-effect is to investigate point defects. In chapter 3, new experimental results are exposed and discussed. Owing to addition of impurities to iron, magnetic after effect, stored energy, resistivity and length measuremetnts have allowed to establish that stage I is correctly explained by the Granato-Nilan model (90); only the last stage, I_E, is related to the interstitial-vacancy annihilation after the interstitial have freely migrated into the network. Several models are discussed for stage II; though it is highly probable that di-interstitials have been observed after electron irradiation, after neutron irradiation none of the after-effect zones can be connected with them. Special phenomena are observed in irradiated iron containing such impurities as nickel, silicium (appearance of new after-effect zones, their transformation); they show the successive complication of an elementary defect: iron interstitial associated wtith an impurity atom. In the last section, some experiments on iron-carbon alloy are described; these show that carbon atoms having precipitated at a temperature lower than 300°C return to solid solution when the alloy is heated above 330°C. Author (ESRO)

N68-30881 Iowa State Univ. of Science and Technology, Ames.
DEFECT–DEFECT INTERACTIONS IN THE SILVER HALIDES WITH SPECIAL APPLICATION TO PURE SILVER CHLORIDE
Richard Anthony Sevenich (Ph.D. Thesis) 1967 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-12994

The effect of defect–defect interactions on the equilibrium concentration of intrinsic Frenkel defects in the silver halides was investigated employing the formalism developed by Allnatt and Cohen. The agreement between the Lidiard theory and this calculation was good below 620°K and above 620°K the Lidiard theory remained a first approximation. Use of a smaller free energy of formation indicated that in this case the Lidiard result was the first term in a slowly converging series at intermediate temperatures. At high T the rising dielectric constant weakened the Coulomb interaction sufficiently so that the theory converged. There were two striking results of the investigation. The first was the occurrence of a maximum in Δg, the change in the free energy of formation due to defect–defect interactions. It was shown that this maximum was to be expected in the case of the Lidiard theory. The second interesting result was that not all input parameters are consistent with the equations of the theory. Dissert. Abstr.

N68-30893 Illinois Univ., Urbana.
THE FREQUENCY DEPENDENCE OF DISLOCATION DAMPING IN SINGLE CRYSTAL COPPER
Clinton Rie Heiple (Ph.D. Thesis) 1967 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11862

The frequency dependence of the amplitude dependent and amplitude independent dislocation damping was measured on the same high purity copper single crystal in both the kilocycle and megacycle frequency ranges. The dislocation contribution to the elastic modulus was also measured in the kilocycle range. The results are discussed in terms of a theoretical calculation which treats the dislocation as a pinned elastic string which experiences a viscous drag proportional to its velocity. The amplitude dependent internal friction of the specimen in the kilocycle range was found to be frequency dependent in the annealed state and to be frequency independent in the irradiated state. The strain amplitude above which the specimen exhibited amplitude dependence was observed to increase with frequency in the kilocycle range. Dissert. Abstr.

N68-30897 Illinois Univ., Urbana.
ZENER DISACCOMMODATION IN DILUTE F.C.C. ALLOYS
Howard Berton Aaron (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-11816

The magnetic disaccommodation, i.e., the time dependence of the low field magnetic permeability, was investigated in cobalt base alloys containing 0 to 5.1 atomic % titanium in the temperature range 400° to 700°C. A strong temperature dependence of the disaccommodation observed in the range 430–530°C could be accounted for predominantly by a single first order relaxation process. Analyzing the data in terms of a) a single Debye relaxation, b) a lognormal distribution of relaxation times, and c) a sum of exponential relaxations it was shown that the relaxation strength varies as the square of the titanium concentration and the relaxation is characterized by an activation energy of 66 ± 3 K cal/mole and a τ_0 of the order of 10^{-16} sec^{-1}. The disaccommodation was attributed to the reorientation of substitutional solute atom (titanium) pairs. From the temperature dependence of the relaxation strength the binding energy of Ti atom pairs was determined to be $0.17 \pm .06$ eV. Dissert. Abstr.

N68-30898 Rice Univ., Houston, Tex.
MOSSBAUER GAMMA-RAY DIFFRACTION
James Patrick Hannon (Ph.D. Thesis) 1967 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-13078

Using the Feynman techniques of quantum electrodynamics, we develop the theory of the interaction of Mossbauer γ-rays with crystals containing the resonant nuclei. The optics of the 14 4-KeV57 γ-ray has been developed in detail, account being taken of the interference of the electronic and nuclear scattering, the Zeeman splittings of the nuclear levels, and the effect of virtual photon–phonon exchanges between the scatteres. The dynamic theory of Bragg reflection, Borrmann transmission, and grazing incidence from Mossbauer crystals is worked out. Some noval magneto-optical properties are obtained for ferromagnetic and antiferromagnetic crystals. The theory is applied to the analysis of the available experiments. Dissert. Abstr.

N68-30899 Cornell Univ., Ithaca, N. Y.
COHERENT STATE AND ITS APPLICATION TO QUANTUM STATISTICAL MECHANICS
Kian Seng Dy (Ph.D. Thesis) 1967 68 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-12341

The application of the coherent state basis to quantum statistical mechanics is studied. For a system in thermodynamics equilibrium, a coherent state phase space distribution function (d.f) defined as the coherent state expectation value of the density matrix is introduced. The canonical partition function which determines all the thermodynamics properties of the system is derived through the coherent state d.f. The result is closely ralated to the Gibbs phase space integral and the classical correspondence is easily established. For a system in non-equilibrium, the equation of motion of the coherent state d.f. is derived through the quantum Liouville equation. In particular, a system of phonons in a slightly anharmonic solid is studied. A quantum mechanical version of the Brout–Prigogine master equation for anharmonic solids is derived by using the method of semi-invariants. This technique exhibits higher order correction in a usable form. The Peierls equation for the time rate of change of the number of phonons is derived from the Brout–Prigogine master equation. Dissert. Abstr.

N68-30902 Delaware Univ., Newark.
SOME GENERAL SOLUTIONS TO PIEZOELECTRIC PROBLEMS OF ELECTROELASTICITY
Rudolph Richard Rizzo (Ph.D. Thesis) 1966 307 p
Available from Univ. Microfilms: HC $13.95/MF $13.95 Order No. 67-11731

A general technique of solution for two-dimensional piezoelectric problems is formulated. In this method, three linear partial differential equations are derived in terms of stress and electric potentials for a homogeneous anisotropic body bounded by cylindrical surfaces where the extraneous effects do not vary along the cylinder generators. The equations are specialized, for a generalized plane deformation, to a single sixth order equation, and a solution is given in terms of three general complex functions associated with the characteristic values of a sixth order polynomial equation. In a similar way the solution for the electric potential in free space is given in terms of a general complex function. By representing these functions in the form of infinite series of complex variables the pertinent boundary relations can be systematized and thus lead to a more or less straightforward solution. Several illustrative boundary value problems are solved in detail along with some numerical calculations. Dissert. Abstr.

N68-30909 Clemson Coll., S. C.
THE EFFECT OF STRAIN ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF VACUUM DEPOSITED INDIUM FILMS

William James Reid, Jr. (Ph.D. Thesis) 1967 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-12598

Thin vacuum-deposited, superconducting films have been stretched and compressed *in situ*, to which there is no previous reference in the literature. Deposition was upon thin glass substrates, and straining was accomplished by bending these. Qualitative vindication of previous data showing that the transition temperature of lead decreases as film thickness becomes very small was found. Dissert. Abstr.

N68-30912 Rochester Univ., N. Y.
SUPERCONDUCTIVITY IN SMALL SYSTEMS
Ronald Parke Groff (Ph.D. Thesis) 1967 172 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13624

The primary objective of the present work was the fabrication of improved cylinders of the Little–Parks type in order that quantitative comparisons could be made between theory and experiment. By going to improved samples it was possible to construct detailed phase diagrams (critical field *versus* temperature) for Al and Sn microcylinders which are in good agreement with predictions of the linearized Ginzburg Landau theory. A second aspect of the present study is that it provides information about current-induced depairing in superconductors which is not accessible in other types of experiments. This facet of the results is discussed within the framework of the generalized depairing theory. Finally, a discussion of thermodynamic fluctuations in superconductors is presented and it is pointed out how such fluctuations interfere with experiments on small superconducting systems. Dissert. Abstr.

N68-30913 Illinois Univ., Urbana.
SOME PROPERTIES OF SILICON p–"i"–n DIODES COMPENSATED WITH GOLD
John Sylvester Moore (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-11885

The electrical and optical properties of gold-doped silicon p–i–n diodes at low and moderate current injection levels are examined. The forward J–V characteristic of these diodes follows Ohm's law at the lowest injection levels. At slightly higher levels the current density in many cases is very nearly proportional to the cube of the applied voltage. At still higher injection levels the current develops an oscillatory component whose frequency can vary between 5 and 100 MHz depending on the gold concentration in the i region of the devices. From illumination of the devices with light various energies it has been established that the gold acceptor deep-level is the only level which plays a role in the dc and the ac behavior of the devices. Dissert. Abstr.

N68-30916 California Univ., Los Angeles
THE MOSSBAUER EFFECT OF IRON 57 IN BULK AND ULTRA FINE NICKEL OXIDE
Ken John Ando (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-14289

The Mossbauer effect of Fe^{57} was investigated in bulk and ultra-fine NiO particles. The results of this investigation show that Fe^{57} exists in both the divalent and trivalent ionic states with the relative concentrations being strongly dependent on sample preparation. The relative intensity ratio of the divalent and trivalent spectra was measured as a function of temperature and was observed to show a drastic temperature dependence. The drastic change in the intensity ratio is discussed on the basis of stoichiometry considerations and a mechanism is proposed to explain the temperature dependence of the intensity ratio. Dissert. Abstr.

N68-30921 California Univ., San Diego.
INTERNAL PROPERTIES OF ABRIKOSOV FLUXOIDS IN TYPE 2 SUPERCONDUCTORS
Roland Eugene Leedon (Ph.D. Thesis) 1967 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-13443

The Green's function equations for superconductivity have been used to study some internal properties of Abrikosov fluxoids in Type 2 superconductors. Approximate Green's functions for a bulk pure superconductor with one fluxoid have been obtained by a modification of Werthamer's theory for local superconductivity. These Green's functions predict a finite local density of states near the fluxoids for all energies, including those less than the local order parameter. The total density of states near the Fermi energh due to one fluxoid is equal to the density of states for a cylinder of normal metal with a radius of about one coherence distance, in agreement with Caroli et al. The densities of states were used to estimate the effect of fluxoids on the nuclear spin relaxation rate for Type 2 superconductors. Equations for the distribution of charge density and electrostatic fields throughout a fluxoid were obtained by expanding the Green's functions of the system in powers of the order parameter. Dissert. Abstr.

N68-30922 California Univ., Los Angeles.
ULTRASONIC ATTENUATION AT LOW TEMPERATURES IN POTASSIUM AND GOLD
Giovan Giuseppe Natale (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-14317

The present investigation is primarily an experimental study of the electron-lattice ultrasonic attenuation in potassium. The acoustic measurements were made with a pulse-echo technique,, by propagating Young's modulus waves in thin polycrystalline wires at frequencies between 200 kc/sec and 400 kc/sec and temperatures from 2.5°K to 77°K. Measurements of electrical resistivity as a function of temperature, needed to compute the theoretical attenuation, were made with a four lead potentiometer method. The results indicate that the attenuation is higher than predicted by a factor of 1.6, with an experimental uncertainty of 10%. A possible additional error due to an imperfect knowledge of the background loss is not likely to reduce the discrepancy; however, the calculated value of the attenuation is subject to an uncertainty of 25%. Dissert. Abstr.

N68-30923 Rensselaer Polytechnic Inst., Troy, N. Y.
MICROWAVE TRANSMISSION THROUGH MAGNETOPLASMAS IN SILICON AND INDIUM ANTIMONIDE
James Caffrey Daly (Ph.D. Thesis) 1967 116 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-12835

The propagation of microwaves at 9.4 GHz through semiconductor wafers across x-band wave guides in the presence of a longitudinal magnetic field is studied. The investigation is motivated by the need to find microwave control devices that will operate higher frequencies and higher power levels. Experimental data is taken using n-type Silicon wafers with a room temperature resistivity of 35, 20, and 4 ohm–cm, and undoped Indium Antimonide wafers with a room temperature resistivity of .05 ohm–cm, that have been cut along the (111) plane. The microwave transmission is related to the material properties through the solution of the wave guide circuit problem. A lumped one port equivalent circuit is developed that accurately represents the interaction of wafers with the microwaves and has easily calculable parameters. Calculations of material properties from the microwave transmission are based on the distributed transmission line equivalent circuit representation of the wafer. Dissert. Abstr.

N68-30928 Rice Univ., Houston, Tex.
MICROWAVE MAGNETIC RESONANCE AND ABSORPTION IN DYSPROSIUM SINGLE CRYSTALS
Howard Allan Blackstead (Ph.D. Thesis) 1967 164 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-13054

Microwave power absorption has been observed at a frequency of 9.45 GHz in single-crystal c-plane platelets of dysprosium at temperatures from 40°K to 179°K. The dc magnetic field was aligned parallel to an a-axis (easy axis) or a b-axis (hard axis), with the rf field either perpendicular, parallel, or at an angle of thirty degrees to it. A theory is developed which assumes an adiabatic nonresonant process in which the magnetic moments "follow" the rf field in such a way as to minimize the free energy of the magnetic system. The theory, employing the enormous magnetoelastic coupling as an energy loss mechanism, gives good qualitative agreement with the observed broad field dependent power absorption. An equation of motion approach to calculate the resonant frequency for the antiferromagnetic state as a function of magnetic field has been generalized to include magnetoelastic coupling and the basal plane anisotropy, and is carried to third order in the magnetic field. Dissert. Abstr.

N68-30929 Rice Univ., Houston, Tex.
THE EFFECTS OF DRIFT FIELD AND FIELD GRADIENT ON THE QUANTUM EFFICIENCY OF PHOTOCELLS
Rashid Mohammed Said Al-Rifai (Ph.D. Thesis) 1967 89 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-13051

The performance of radient energy cells has been reviewed with an emphasis on the role of the quantum efficiency (spectral response) of the cell in determining the conversion efficiency. Previous works concerning drift field effects on the quantum efficiency of the cell have also been reviewed. Quantum efficiencies of the diffused and base layers were evaluated mathematically for both field free and finite field cases. A single region model was used for evaluating the quantum efficiency of the diffused layer and a two-regions model was adopted for the base layer. The electrostatic potential was obtained for three impurity density functions of the type encountered in practice. It has been found that the criterion for improving the quantum efficiency is to keep the drift field as high as possible while minimizing the field gradient. This was related to the impurity density function. Appropriate grading of the base layer impurities may produce improvement in its quantum efficiency. Dissert. Abstr.

N68-30931 California Univ., Davis.
OPTICAL PROPERTIES AND ELECTRONIC BAND STRUCTURE OF ZINC: REFLECTANCE AND PHOTOEMISSION STUDIES
Lawson Paul Mosteller, Jr. (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-14979

Reflectance and photoemission measurements were used to investigate the optical properties and electronic band structure of Zn. The quantum yield, work function, energy temperature dependence of photoemission was measured on a single crystal of Zn cleaved in the basal plane. The crystal was cleaved and measurements made at pressures of 10^{-9} torr to ensure surface cleanliness during reflectivity measurements. The reflectometer designed for these measurements is described in detail. The reflectivity for the basal plane was measured for four different angles of incidence in the range 50–70°. Air exposure drastically reduced the reflectivity. Theoretical expressions for the reflectance coefficients for the basal plane are derived in terms of angle of incidence, polarization, and the four optical constants. An improved technique for measuring the energy distribution of photoelectron was used to investigate the electronic band structure to a depth of 8 eV below the Fermi surface. Dissert. Abstr.

N68-30934 Missouri Univ., Rolla.
MAGNETIC PROPERTIES OF THE $BiFeO_3$–$PbTiO_3$–$PbZrO_3$ TERNARY SYSTEM
James Ivan Latham (Ph.D. Thesis) 1967 239 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-12020

The magnetic susceptibility and spontaneous magnetic moment of the perovskitic, polycrystalline solid solutions of $BiFeO_3$ with $PbTiO_3$, $PbZrO_3$, and $[50PbZrO_3 \cdot 50PbTiO_3]$ were determined using the Faraday method. Pure $BiFeO_3$ has a G-type antiferromagnetic structure. Although the perovskite $BiFeO_3$ exhibits a sharp peak in the susceptibility of the Neel temperature, it does not possess a spontaneous magnetic moment. The solid solutions investigated possessed a spontaneous magnetic moment throughout the multiple cell rhombohedral region of the $BiFeO_3$–$PbTiO_3$–$PbZrO_3$ ternary phase diagram, which extends from pure $BiFeO_3$ to 75 to 80 percent $BiFeO_3$ content on both sides and extends to nearly 50 percent $BiFeO_3$ content in the center region. Except for some anomalous cases in the $BiFeO_3$–$PbTiO_3$ system, no spontaneous magnetic moments were observed outside the multiple cell rhombohedral region. Dissert. Abstr.

N68-30939 Pittsburgh Univ., Pa.
MICROWAVE PHONON ABSORPTION IN NORMAL AND SUPERCONDUCTING ALUMINUM
Edward Allen Fagen (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-12591

Initial measurements are reported on the attenuation of longitudinal ultrasound by pure aluminum over the temperature range from 0.36 to 1.2°K at a frequency of 9.3 GHz. At this frequency, the phonon energy is no longer negligible compared to the superconducting energy gap, and the possibility exists of phonon decay via the excitation of quasiparticles across the gap, in addition to the usual quasiparticle scattering process. Data on both a polycrystalline and monocrystalline sample exhibit a discontinuity of the order of 22% of the normal state attenuation, approximately five millidegrees below the transition temperature, T. These results are compared with computations based on the Bardeen–Cooper–Schrieffer theory of superconductivity, and the discontinuity is tentatively attributed to the sudden onset of the gap-jumping process. Dissert. Abstr.

N68-30940 Pittsburgh Univ., Pa.
MAGNETIC FIELD DEPENDENCE OF MILLIMETER WAVE ABSORPTION IN BULK SUPERCONDUCTING ALUMINUM
Walter Valerian Budzinski (Ph.D. Thesis) 1967 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-12587

The effect of a static magnetic field on the absorption of microwaves has been measured for the frequency range 15 to 100 Gcps in bulk superconducting samples of pure aluminum and aluminum containing 0.2 atomic percent silver impurities. Using a calorimetric technique, measurements were made at a low temperature ($T = 0.34\ T_c$) and the absorption was always observed to increase with increasing magnetic field. In pure aluminum, the effect of the field is to spread out the absorption edge associated with the superconducting energy gap. Dissert. Abstr.

N68-30944 North Carolina State Coll., Raleigh.
XENON-133 DIFFUSION IN SINGLE CRYSTAL CESIUM-IODIDE
Ronald Peter Christman (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-11976

The diffusion characteristics of the fission rare gas xenon-133 in cesium-iodide single crystals are examined employing a new

gas doping technique. Comparisons are made with crystals tagged with conventional fast neutron irradiation. Gas releases are measured using a continuous radioassay apparatus for annealing periods up to four days. The results verify classical predictions in the instances where crystalline growth defect concentrations are low. Crystals containing localized defects causing crystal opacity exhibit a burst release pattern similar to those observed in uranium dioxide. Diffusion coefficient data indicate that the burst is the true diffusional portion for these crystals. Storage in varying environmental conditions does not produce deviations from classical releases. Fast neutron-tagged crystals exhibit a degradation in diffusion coefficient indicating the dose dependence of coefficients determined from this type of doping method. Dissert. Abstr.

N68-30950 Michigan State Univ., East Lansing.
THE INTERACTION OF SPIN WAVES WITH DRIFTED CONDUCTION ELECTRONS
Bruce Curtiss Burkey (Ph.D. Thesis) 1967 82 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-14480

The elementary excitations of a ferromagnetic or ferrimagnetic material are magnetoelastic waves if the material has appropriate magnetoelastic properties. A magnetoelastic wave may be predominantly spin wave or it may be an admixture of both a spin wave and an elastic wave, depending on the magnetic, elastic and magnetoelastic characteristics of the material and the wave vector of the excitation. If, in addition, the material has appropriate deformation potential or piezoelectric properties, and is a semiconductor, the magnetoelastic excitations may intereact with the drifted charged particles, the drifing drifting being caused by an externally applied electric field. The purpose of the present work is to investigate theoretically the interaction between the predominantly spin wave magnetoelastic waves and drifted charged particles. The model material considered is an n-type ferromagnetic semiconductor with idealized magnetoelastic, piezoelectric and deformation potential properties., Dissert. Abstr.

N68-30973 Howard Univ., Washington, D. C.
OPTICAL AND ELECTRICAL PROPERTIES OF RARE EARTH THIN FILMS
Ogba Agba Okorie (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-13560

This investigation concerns the optical and electrical properties of some rare earth thin films deposited by vacuum evaporation. Qualitative studies were carried out on the effect of aging and x-irradiation on the transmission of the thin films. Ytterbium, Neodymium and Samarium thin films were included in this study. The quantitative study was based on the Yb film data, and only qualitative study was made on the Sm and Nd films. The work covers the spectral region 0.8 to 6.8 microns in the infrared. Theoretically, the optical properties, refraction, absorption, emission, reflection and transmission are related and may be described by two optical constants, the refractive index n, and the extinction coefficient k. From the transmission and reflection data, the refractive index n, the extinction coefficient k, and the absorption coefficient were obtained. The resistivity measurements yielded information concerning the types of carriers and their densities. The resistivity and absorption coefficient data confirm Bridgman's prediction that Ytterbium can become a degenerate semiconductor due to pressure effects. Dissert. Abstr.

N68-30978 Cornell Univ., Ithaca, N. Y.
AUDIO FREQUENCY ELECTROMAGNETIC PROPERTIES OF NORMAL AND SUPERCONDUCTING INDIUM
Edwin Freeman Johnson (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-12616

Helicon-like resonances have been observed in the intermediate state of high-purity polycrystalline indium, and an experimental investigation of their properties has been made. The dependence of the resonant amplitudes on the steady magnetic field and the temperature can be understood in terms of helicon theory providing the field-dependent relative permeability is included in the expression for the resonant amplitudes. Furthermore, the "Hall angle" derived by means of helicon expressions has a dependence on the steady magnetic field which is remarkably like that obtained by conventional techniques. In contrast, the "resistivity" and "Hall resistivity" calculated from the helicon expressions can not be understood by a reasonable model of the intermediate state. As an extension of the studies of the intermediate state, the normal state helicon was investigated in the limit of small steady magnetic fields ($\omega_c \tau < 1$). The resistivity and Hall coefficient derived from the helicon agree ($\pm 15\%$) with those found by conventional measurements except at the lowest fields ($\omega \tau_c \leq 0.5$). Dissert. Abstr.

N68-30981 Cornell Univ., Ithaca, N. Y.
SOLID STATE REACTIONS AT THE NICKEL–ALUMINUM OXIDE INTERFACE
Alvin Howard Feingold (Ph.D. Thesis) 1967 109 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-12347

Grain boundary grooving in the solid state was studied at the nickel-aluminum oxide interface. The kinetics of the grooving process was found to have a $(\text{time})^{1/3}$ dependence at high temperatures. The activation energy for the process was determined to be 70.6 ± 3.8 kcal/mole which corresponds to volume diffusion of aluminum in the nickel. When pure nickel was used as the metal phase, the agreement between the calculated and measured rate constant was good at high temperatures where volume diffusion was the controlling mechanism. In the case where a nickel-aluminum alloy was used as the metal phase qualitative agreement was obtained for the variation with concentration. The solid-solid interfacial tension as determined from the equilibrium shape of the grain boundary groove yielded a value of 2500 ergs/cm^2 for the temperature range studied (1350–1425°C). It was determined that addition of aluminum to the metal phase lowered the solid-solid interfacial tension. Dissert. Abstr.

N68-30982 Cornell Univ., Ithaca, N. Y.
REVERSIBLE AND IRREVERSIBLE MAGNETIC PROPERTIES OF SOME TYPE 2 ALLOY SUPERCONDUCTORS
William Adolf Fietz (Ph.D. Thesis) 1967 139 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-12609

Magnetization curves of some high purity niobium base alloy superconductors were measured using both carefully annealed and heavily cold-worked specimens. The reversible curves of the annealed specimens yielded temperature and electronic mean free path dependence of the basic superconducting parameters. The hysteretic curves of the cold-worked specimens gave data on the pinning forces associated with the interaction between the fluxoid lattice and the dislocation structure in the material. The magnetization curves were obtained by electronic integration of the difference between the voltage induced in a coil surrounding a long cylindrical specimen and the voltage induced in an empty coil, as the applied magnetic field was slowly varied. Regions of instability or flux jumping occurred in the cold-worked specimen when the magnetic field fully penetrated the material and critical current density increased above some threshold value of about 2×10^4 amp/cm^2. Dissert. Abstr.

N68-30983 Pennsylvania Univ., Philadelphia.
AN INVESTIGATION OF THE FERMI SURFACE OF ARSENIC USING AZBEL'-KANER CYCLOTRON RESONANCE AND THE DE HAAS–VAN ALPHEN EFFECT

Richard Michael Josephs (Ph.D. Thesis) 1967 177 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-12762

We have used Azbel'-Kaner cyclotron Resonance (AKCR) and the de Haas-van Alphen effect (dHvA) to determine the Fermi surface (Fs) of arsenic. The AKCR experiments were performed at 70 GHz with the magnetic field oriented in the trigonal plane of a cleaved arsenic crystal. Most of our information about the Fs of arsenic came from a study of the dHvA effect in pulsed magnetic fields extending up to 190 kG. Although both the electron and hold portions of the Fs of arsenic exhibit departures from the ellipsoidal topology, we fitted the short period data to an ellipsoidal model. Using these values, we find that the tilt angles of the electron and hold ellipsoids are 83.1°±2° and 37.9°±2° respectively. Assuming an ellipsoidal model, we find that the Fermi energies of the electron and hold ellipsoids are 194 mev ±10% and 176 mev±10%respectively. In conclusion, we find that the Fs of arsenic consists of 3 distorted ellipsoidal pockets of electrons and 6 warped ellipsoidal pockets of holes. Dissert. Abstr.

N68-30987 California Univ., San Diego.
THE SUPERCONDUCTING ISOTOPE EFFECT IN MOLYBDENUM BORIDE AND TUNGSTEN BORIDE
John Joseph Engelhardt (Ph.D. Thesis) 1967 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-12285

The isotope effect on the superconducting transition temperature was measured for the compounds Mo_2B and W_2B. Both the heavy masses and the B mass were varied independently in each compound. The compounds have isomorphous crystal structures with nearly identical lattice parameters. The effect of changing the boron mass appeared to be small in both compounds. The Mo and W isotope effects were much larger. Under the assumption that the Mo_2B lattice was made up of only the Mo mass, the Mo isotope effect was found to be the same as that found in elemental Mo. By considering the W isotope effect in W_2B analogously, the elemental W isotope effect is predicted to be the same as that found in non-transition element superconductors. The role of the d electrons in Mo and W is discussed in light of these results. Dissert. Abstr.

N68-30997 Rice Univ., Houston, Tex.
AN INVESTIGATION OF THE SPIN-LATTICE RELAXATION TIME OF TRIVALENT URANIUM IN CALCIUM FLUORIDE
Robert Turner Haase (Ph.D. Thesis) 1967 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13077

The spin-lattice relaxation time of U^{3+} in CaF_2 was measured at liquid helium temperatures. The experimental results are compared to a theoretical prediction made by P.L. Donoho and T.D. Black. It was found that the experimental values were less than the predicted values by approximately an order of magnitude and had a different angular dependence. To try to explain this discrepancy, the interaction between dislocations and paramagnetic ions is considered. A mechanism involving jumping of charge compensating fluorine interstitial ions to effect more rapid spin-lattice relaxation rates is also discussed. Recent work by D. Hadaway has shown that these interstitials are highly mobile. Future experiments to test the effectiveness of these mechanisms are suggested. Dissert. Abstr.

N68-31005 Clemson Coll., S. C.
ELECTRON SPIN RESONANCE STUDIES OF TRI-VALENT GADOLINIUM IN CALCIUM FLUORIDE SINGLE CRYSTALS UNDER APPLIED STRESS
Charles Malcolm Bowden (Ph.D. Thesis) 1967 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-12601

The electron paramagnetic resonance spectrum of Gd^{3+} in cubic sites of CaF_2 under applied stress has been studied. The stress was administered in two ways: by applying a uniaxial stress to the crystal at room temperature in the microwave cavity, and by depositing a thin Ge film epitaxially on a polished (111) of a thin slab of the crystal. Stress was induced in the latter by changing the temperature of the sample in the microwave cavity. The ESR spectra of two sections of the epitaxial crystal, one having had the film etched off, were studied separately over the temperature range from about room temperature to 93°K and at the same orientation with respect to the applied magnetic field direction. Relative shifts in the magnetic field positions of each fine structure component showed a definite correlation between the sign of the value for $M_s \rightarrow M_s - 1$, and the sign of the slope of the least squares straight line relating the observed shift in magnetic field position with temperature change. Dissert. Abstr.

N68-31024 Illinois Univ., Urbana.
CRITICAL FIELD OF SUPERCONDUCTING ALUMINUM AS A FUNCTION OF PRESSURE AND TEMPERATURE ABOVE 0.3°K
Erik Preston Harris (Ph.D. Thesis) 1967 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-11860

The critical field curve of aluminum has been measured from T_c to 0.3°K, at pressures ranging from 0 to 7200 psi. Using calorimetrically derived values for the low-temperature superconducting electronic specific heat, the data have been extrapolated to T = 0, yielding values for H_o and γ. These values and experimental results for T_c are then used to calculate the superconducting electronic entropy and the deviation of the critical field curve from parabolicity over the entire temperature range. The results show excellent agreement with previous calorimetric measurements of the thermodynamic properties of superconducting aluminum. The shape of the reduced critical field curve shows no pressure dependence over the range of pressures used. Dissert. Abstr.

N68-31028 Delaware Univ., Newark.
COMBINED OPTICAL AND ELECTRICAL EFFECTS IN SINGLE CRYSTALS OF ZnS:Mn
Chava Fischler (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-11723

Single crystals of ZnS:Mn were grown, and the effect of infrared and ultraviolet radiations on electroluminescence in them was investigated. Oscillations in current and in electroluminescence, which were observed in these crystals, were also studied. As a background for the study of the effect of IR on uv-induced electroluminescence, the effect of IR on uv-excited photoluminescence and photoconductivity was also studied. The usual 0.75μ and 1.3μ IR bands for quenching of photoconductivity and green photoluminescence were found. The inown stimulation flashes of the orange Mn emission on application of IR were also observed, and were found to have the same IR spectral dependence as the quenching effect. Application of IR in the dark gave enhancement factors up to 200 in current, and up to 100 in electroluminescence. The interpretation of this effect is not certain, but it is very likely that it is an IR excitation of current and PEL instead of just an enhancement of a slowly decaying effect of previous uv excitation. Dissert. Abstr.

N68-31029 George Washington Univ., Washington, D. C.
A NON-LINEAR CONTINUUM THEORY OF ALKALI METALS BASED ON QUANTUM MECHANICS
John Eftis (Ph.D. Thesis) 1967 160 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-11772

A hyperelastic theory of the Alkali metals for prescribed non-linear deformations at absolute zero temperature is presented, and is based on a strain-energy function which is obtained by means of the Quantum Theory of solids. The total energy of a monovalent Alkali crystal at absolute zero temperature is calculated in the one-electron approximation in conjunction with the method of Wigner and Seitz. The almost free electron-like behavior of the valence electrons coupled with the small and widely spaced ion core structures, characteristic of Alkali metals, permits analytical representation of the various contributions to the total energy of the crystal. Perfectly elastic response of the metals is assured by requiring shear components of imposed deformation to be infinitesimal in magniture, while normal components may be finite but not arbitrarily large. Deformations satisfying these requirements are termed prescribed deformations. Dissert. Abstr.

N68-31063 Utah Univ., Salt Lake City.
THE EXCHANGE CHARGE MODEL OF ALKALI HALIDES
Ralph L. Marston (Ph.D. Thesis) 1967 363 p
Available from Univ. Microfilms: HC $16.45/MF $4.65 Order No. 67-11946

In an effort to understand certain difficulties associated with the shell model of ionic crystals and to investigate the dynamic consequences of the exchange model, an extension of the shell model has been studied. Small, positive, point exchange charges were assumed to exist at the points of contact between ions of an Alkali helide crystal. On the basis of a simple shell model, Born–Mayer repulsion, and two parameters to control the position and magnitude of exchange charges, the theory of lattice dynamics was used to evaluated parameters in terms of measured quantities. Two approaches to the problem of evaluating parameters were made. The exchange-charge model failed to improve upon the predictions of the simple shell model with either approach. Dissert. Abstr.

N68-31067 Rochester Univ., N. Y.
THE IMPURITY INDUCED INFRARED ABSORPTION IN A MONATOMIC F. C. C. LATTICE
Thomas Patrick Martin (Ph.D. Thesis) 1967 171 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-13633

The infrared absorption by a low concentration of defects in a monatomic fcc lattice has been calculated. The host crystal was assumed to be composed of uncharged atoms interacting only with their nearest neighbors by means of central, harmonic forces. The substitutional defect atom differed from the host atoms in its mass, nearest neighbor force constant, and effective charge. Calculations were made for a rigid, charged defect and for an uncharged, deformable defect. Both the localized mode frequencies and the band mode absorption coefficient were expressed in terms of the Green's functions of Lifshitz. The Green's functions of the perfect lattice were calculated assuming rigid atoms. The symmetry properties of the system were used to reduce the problem from a system of 39 atomic displacement coordinates to only four vector-like symmetry coordinates. The effective charge parameters needed to calculate the absorption coefficient due to an uncharged deformable defect in a lattice of deformable atoms were estimated by means of a simplified shell model. It was shown that such parameters can apparently be used consistently with Green's functions based on a rigid atom model. Dissert. Abstr.

N68-31087 Johns Hopkins Univ., Baltimore, Md.
DYNAMICAL THEORY OF THE HEXAGONAL CLOSE PACKED CRYSTAL LATTICES BASED ON A NONCENTRAL FORCE MODEL
Edward Albert Metzbower (Ph.D. Thesis) 1967 169 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-13816

A Born–von Karman model of the hexagonal close-packed crystal lattice was considered using a combination of central and angular forces between various sets of neighbors. The interactions between nearest neighbors in the plane wave were considered to be central forces while the interaction bewteen both nearest and next nearest neighbors out of the plane were considered to be nocentral forces, i.e., the interactions involved both central and angular forces. The hexagonal close-packed crystal, lattices that were considered had different axial (c/a) ratios. The three metals were beryllium (1.568), magnesium (1.624) and zinc (1.855). The equations of motions were evolved and the atomic force constants were evaluated by three different methods. The atomic force constants were evaluated (1) from the elastic constants by the method of long waves, (2) from a least squares analysis of the eigenvalues of the secular equation for elastic waves propagating in certain symmetric crystallographic directions at critical points in the Brillouin zone, and (3) from a least squares analysis of the elastic constants and the dispersion relations. Dissert. Abstr.

N68-31136 Rutgers Univ., New Brunswick, N. J.
THE SECOND ORDER QUASI-HARMONIC ELASTIC CONSTANTS
Carl Feldman (Ph.D. Thesis) 1967 158 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-14707

The temperature dependence of the second order quasi-harmonic elastic constants, for a face centered cubic lattice using a generalized central force nearest-neighbor model, is calculated. The sums which enter into the calculations are evaluated by direct summation over the Brillouin zone; these are tabulated in the text as a function of the reduced temperature and volume. Application of these calculations to the rare gas solids Xe, Kr, Ar, and Ne is made through the use of special potentials. Estimates of the full anharmonic high temperature dependence of Grüneisen's parameter and the Debye temperature for the rare gas solids Xe, Kr, and Ar are also given. Dissert. Abstr.

N68-31144 Pennsylvania Univ., Philadelphia.
DIPOLAR DEFECTS IN REDUCED RUTILE
Lawrence Adam Konrad Dominik (Ph.D. Thesis) 1967 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-12741

The complex dielectric constant of reduced, semiconducting rutile was measured. Three Debye-type relaxation processes are observed. Since the relaxation processes occur only in reduced specimens, the dc resistivity and Hall coefficient of the dielectric specimens were measured to determine the concentration of intrinsic donor defects (interstitialcies and vacancies) introduced by reduction. The dependence of the relaxation processes upon the extent of reduction, the trivalent extrinsic impurity concentration, and the crystallographic orientation of the dielectric specimens were measured. All of these experiments indicated that the three relaxation processes can be attributed to the reorientation of electronic dipolar defects. The dielectric relaxations are found to be independent of the state of reduction. All three relaxations are ascribed to the intercationic hopping of highly localized electrons (in Ti+3 states) between normal lattice cations adjacent to positive ionic defects induced by reduction and in association with extrinsic impurities introduced in growing the single crystal boules. Dissert. Abstr.

N68-31150 Polytechnic Inst. of Brooklyn, N. Y.
THE ANALYSIS OF TRANSLATIONALLY INVARIANT WAVEFUNCTIONS IN A MAGNETIC FIELD WITH APPLICATION TO FREQUENCY AND WAVELENGTH DEPENDENT TRANSPORT PHENOMENA

Harold Lewis Grubin (Ph.D. Thesis) 1967 273 p
Available from Univ. Microfilms: HC $12.40/MF $3.55 Order No. 67-13391

Translationally invariant magnetic field dependent single particle wavefunctions for electrons in a periodic potential are constructed and used in analyzing frequency and wavelength dependent transport phenomena in metals. The theory is formulated independently of the usual semi-classical approximations. Wavefunctions, expressed in terms of linear combinations of symmetrized Landau functions, have a quasi-Bloch structure. The wave-functions are used in deriving expressions for relevant physical quantities such as the matrix elements of the velocity operator, and 'f'-sum rules are obtained leading to expressions for magnetic field and wave-vector dependent effective masses. The form of these expressions are similar to those of Bloch states in zero magnetic field. Using a density matrix formalism, with the magnetic field dependent wavefunctions as a basis, the magnetic field, frequency and wavelength dependent conductivity coefficients are constructed. An additional feature of this study is a new expression for the diamagnetism of conduction electrons. Dissert. Abstr.

N68-31166 Louisiana State Univ., Baton Rouge.
OSCILLATORY FIELD DEPENDENCE OF THE KNIGHT SHIFT IN A MONOCRYSTAL OF TIN
Sharif Ahmad Khan (Ph.D. Thesis) 1967 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-13992

Magnetic field dependence of the Knight shift was studied in a monocrystal of white tin at 1.2°K and in magnetic fields ranging from 10.5 to 16.2 kG. The Knight shift was found to oscillate at the de Haas–van Alphen frequency and exhibited two periods of 3×10^{-7} and 5.9×10^{-7} G^{-1}. The values and angular variations of these periods are in satisfactory agreement with the data on the tin Fermi surface obtained from other experiments and from a pseudopotential calculation of the band structure. The magnetic field dependence of the amplitude of the oscillations was investigated for both periods. The amplitude of the shorter period component increased and that of the longer period component decreased with increasing magnetic field. The decrease in amplitude of the longer period oscillation is attributed to the effects of magnetic breakdown. The observed amplitudes are in satisfactory agreement with the assumption that the Knight shift oscillations are due to oscillations in the ground state wave functions of the contributing electrons rather than oscillations in the susceptibility as has been previously suggested. Measurements of the de Haas–van Alphen susceptibility in the same sample used for the Knight shift measurements were performed and give further support to this viewpoint since the field variation of the amplitude of the oscillations in the susceptibility is different from the corresponding field dependence of the oscillatory Knight shift. Dissert. Abstr.

N68-31167 Rochester Univ., N. Y.
STUDY OF EXCITATION AND PROPAGATION OF ULTRASONIC WAVES IN QUARTZ AT 114 GHz
John Odeke Ilukor (Ph.D. Thesis) 1967 92 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-13626

Generation and detection of coherent elastic waves in piezo-quartz was extended to 114 GHz (114×10^9cps) where the power delivered to the crystal was about 3 milliwatts. Longitudinal waves were generated and detected (4.2 to 20°K) simultaneously at both ends of a quartz rod which completely filled a rectangular cavity of high mode field configuration, $TE_{1,2,(n)}$ n = 5,10, with the X-axis parallel to the long dimension of the cavity. For any given pulse echo synchronous detector compares output (of superheterodyne receiver) containing noise-plus-signal with noise only. The overall minimum detectable signal is not greater than $\approx 10^{-15}$ watts. The temperature dependent part of the attenuation was found to vary approximately as the fourth power of temperature and whereas this power law suggests three phonon processes, contribution from four phonon processes according to the theory of Orbach and Pomeranchuck was found to be too small to account for the observed attenuation. From these results, the average third order elastic constant is estimated to be between $\pm 10^{13}$ and $\pm 10^{14}$ dynes cm^{-2}. Dissert. Abstr.

N68-31173 Missouri Univ., Columbia.
COLOR CENTERS IN STRONTIUM OXIDE
Bruce Paul Johnson (Ph.D. Thesis) 1967 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-13857

Single crystals of strontium oxide have been additively colored in strontium metal vapor. The crystals were heated in the temperature range 1391°C to 1689°C and for strontium pressures in the range 0.31 to 42.0 torr. The resultant change in the room temperature optical absorption spectrum reveals an asymmetric absorption curve which peaks at 2.50 eV. This has been analyzed to show that the absorption is most probably due to the creation of oxygen vacancies which trap two electrons forming an F' center. The activation energy for this process is found to be—1.1 eV. The additive coloring of strontium oxide in calcium metal vapor is found to produce essentially the same spectrum as heating in strontium metal vapor. The vacuum heating of additively colored crystals in the range 750°C to 1520°C for various times is found to bleach the F' centers at the higher temperatures and to cause the formation of colloids at the lower temperatures. Dissert. Abstr.

N68-31174 Cornell Univ., Ithaca, N. Y.
LOW TEMPERATURE DIELECTRIC PROPERTIES OF Li+ AND CN− IMPURITIES IN KCl AT 22–26GC/SEC
Andras Imre Lakatos (Ph.D. Thesis) 1967 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12620

The complex dielectric constant of KCl doped with Li+ and CN− impurities was measured in the 22–26Gc/sec frequency and 412 to 300°K temperature ranges. Measurements were made with a resonance cavity operated in the TE_{01} mode, with and without dc bias fields. Using the off-center XY_8 impurity model for Li+ in KCl, the average tunneling splitting δ_{av} was 0.80±0.04 cm^{-1}. As a result of stresses present in the sample with the highest concentration of Li+, the originally equal tunneling energies became slightly shifted in that sample, and the results can be interpreted in terms of a double resonance structure with ω_{01} = 0.76 cm^{-1}. In the lower concentration samples the separation between the two resonances seems to be less. In the 30 to 10°K temperature range the resonance width (Γ) and the shift in δ (Σ), due to the impurity-phonon coupling, have a 1/T temperature dependence which is in agreement with theoretical predictions. For the CN− impurity in KCl, XY_8 symmetry and a dipole rotator model were assumed. The tunneling splitting was δ' = 1.10±0.06 cm^{-1} and $2\delta'$ = 2.2±0.12 cm^{-1}. Dissert. Abstr.

N68-31240*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
APPLICATION OF THIN FILMS TO EXTREMELY HIGH FREQUENCIES Semiannual Status Report, 5 Dec. 1967–5 Jun. 1968
Robert L. Ramey Jul. 1968 15 p refs
(Grant NsG-340)
(NASA-CR-66655; EE-4012-110-68U) CFSTI: HC $3.00/MF $0.65 CSCL 20L

An equation relating microwave power transmission to thin film conductivity, film thickness, and frequency for any film is given. Relating a thin film as a window in a waveguide system, the equation is shown as a plot, for different film materials, for TE_{10} mode. A table of cutoff frequencies for some standard waveguides

is given. Although electrical properties of thin films alone are independent of frequency, in their application as waveguide windows the power transmission coefficient depends of frequency. A plot of this relation is presented. Thin film window devices are described which are currently under initial investigation. These devices are: a switch modulator using a thin film electrically floating within a waveguide, a partial reflector using a thin film to reflect in a waveguide tee, and tuned cavities bounded by a thin film. D.H.B.

N68-31258 Johns Hopkins Univ., Baltimore, Md.
EFFECT OF HOPPING CONDUCTIVITY ON THE ATTENUATION OF 9GHz ACOUSTIC WAVES IN CADMIUM SULPHIDE
Donald Lee Denburg (Ph.D. Thesis) 1967 144 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-13791

Experiments performed in an effort to produce amplification of 9.0 GHz acoustic waves in cadmium sulphide at 4.2°K revealed that existing theories were inadequate to explain the phenomena which were observed. A systematic investigation was undertaken to find other attenuation mechanisms to account for the experimental results. The photosensitive attenuation of 9.0 GHz longitudinal waves was measured as a function of the illumination intensity, F, and found to be proportional to $F^{0.2}$ in lithium doped crystals. Attenuation constants larger than 40 db/cm were measured for Cl− doped crystals. Photo–Hall measurements revealed that at T<20°K charge transport was via dc hopping photoconductivity in a shallow compensated donor level, which was found from 0.020eV to 0.035 eV below the conduction band. An ac hopping conductivity was assumed to exist along with its dc counterpart, and both conduction mechanisms were incorporated into the existing attenuation theories; the effects of the ac hopping photoconductivity were shown to dominate the attenuation at low temperatures. Acoustic interactions with drifting electrons freed from the shallow trapping level by impact ionization exhibited the directional dependence predicted by the attenuation theory. Dissert. Abstr.

N68-31275 Rutgers Univ., New Brunswick, N. J.
FREQUENCY DEPENDENCE OF THE PARAMAGNETIC RELAXATION IN A COPPER TUTTON SALT AT LIQUID HELIUM TEMPERATURES
Thomas Edward Pratt (Ph.D. Thesis) 1967 67 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-14747

The purpose of this study was to determine whether the direct process and orbit-lattice mechanism can explain the paramagnetic relaxation in a copper Tutton salt, at liquid helium temperatures for various dilutions of the copper ions with zinc, particularly with respect to the frequency dependence of the relaxation rate. The validity of time independent transition probabilities is assumed for the simultaneous change in orientation of the paramagnetic ion in an external magnetic field and creation of a phonon with the magnetic resonance frequency. The frequency dependence provides a good test of this explanation, since it predicts a frequency to the fourth power dependence of the relaxation rate for ions, such as copper whose ground states in the host lattice are doublets, split only by an external magnetic field. The direct process with the orbit-lattice mechanism cannot explain the decay times observed at the higher concentrations. At the lowest concentration observed, with the b-axis parallel to the field, the frequency dependence appears to be consistent with the mechanism. However the failure to maintain this dependence in the other orientation makes such an interpretation doubtful. Dissert. Abstr.

N68-31281# Compagnie Francaise Thomson-Houston, Bagneux (France).
TRANSIENT EXCITATION OF SPIN WAVES BY TRANSVERSE SURGE [EXCITATION TRANSITOIRE D'ONDES DE SPIN PAR POMPAGE PERPENDICULAIRE]
Edouard Milot (Ph.D. Thesis—Paris Univ.) [1967] 108 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

This is a study of the resonance saturation of a monocrystalline ferromagnetic material limited to the case where the resonance is caused by the first order terms, i.e. the case where the coupling of nonlinear spinwaves with a frequency is equal to half the resonance frequency. The behavior of the system is analyzed in the linear regime. It is shown that the material's own radiation cannot be neglected. The nonlinear regime leeds to a set of nonlinear differential equations. It is assumed that the spin waves are excited to resonance level by the first order elements. The differential system is the base of the study of the stationary regime. Test equipment is described and experimental results are given. ESRO

N68-31311# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN ASPECTS OF PULSE DISCHARGES IN A VACUUM [NEKOTORYYE VOPROSY IMPUL'SNYKH RAZRYADOV V VAKUUME]
S. L. Kel'bert, R. B. Nagaybekov, and A. M. Yagudayev 20 Oct. 1967 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (Tashkent), no. 1, 1966 p 81–84
(FTD-HT-67-374; AD-670903)

Consideration is given to some problems of heavy-current commutation and erosion of electrodes made of refractory metals (Mo, W) in a vacuum. An analysis is made of the diffusion products precipitated on various base layers. The erosion of Mo, W electrodes has been determined in a vacuum in a pulse discharge. A qualitative dependence of the products of erosion on the parameters of the circuit is detected. A possibility is established for the creation of coatings of refractory metals of various density. Author (TAB)

N68-31334# Delaware Univ., Newark. Dept. of Physics.
LOW ENERGY SPUTTERING Final Report, May 1965–Dec. 1967
Charles B. Cooper Feb. 1968 21 p refs
(Contract DA-18-001-AMC-748(X))
(AD-671049)

Various experiments on low energy sputtering (the ejection of particles from a solid surface under ion bombardment in a vacuum) was performed. Apparatus was constructed to coat the tip of thermocouples with a 2 micron layer of nickel obtained by sputtering, for evaluation and comparison with similar films formed by other means. Several thermocouples were coated. Several compound semiconductor crystals were sputtered. This work included measurements of sputtering yields, mass spectrometric study of the sputtered particles, and a study of the angular distribution of the sputtered atoms. The angular distribution of sputtered atoms from metallic single crystals was studied, as a function of target temperature, of bombarding ion energy, of the angle of incidence of the bombarding ion, and finally at very low ion energies. Instrumentation work was done on the measurement of the average kinetic energy of particles sputtered of a Cu single crystal were made, and a search for negative sputtered ions carried out. The sputtering yield of singly crystal faces of Ag at low ion energies were measured. Finally, preliminary work was carried out on the low energy sputtering of insulators. Author (TAB)

N68-31339 Cornell Univ., Ithaca, N. Y.
THE BEHAVIOR OF POINT DEFECTS IN SOME FLUORITE CRYSTALS
Edwin Howard Barsis (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-12330

The ionic conductivity of BaF_2, SrF_2, CaF_2 and $SrCl_2$ doped with aliovalent impurities has been investigated from 300°C

to within 100°C of the melting temperature. These measurements confirm a Frenkel anion disorder model for the fluorides and establish the intrinsic conductivities. An extensive investigation of BaF_2–GdF_3 and BaF_2–BaO leads to values for the anion vacancy and interstitial mobilities, the impurity-defect association energies, and the solubility of O^{-2} in BaF_2. The results of measurements on BaF_2–NaF,KF and BaF_2–NaF–O_2 show that potassium and sodium dissolve interstitially in BaF_2. The values determined in this study are shown to agree with the values deduced from NMR and electric-elastic reorientation measurements or to be consistent with them using plausible assumptions, and to agree with the corresponding values in the other fluorides on the basis of elementary theoretical considerations. Dissert. Abstr.

N68-31355# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires
TUNNELING IN CRYSTALS [LA CANALISATION DANS LES CRISTAUX]
Michel Dupuy (Ph.D. Thesis) Mar. 1968 56 p refs In FRENCH; ENGLISH summary
(CEA-BIB-118) CFSTI: HC$3.00/MF$0.65

After a short introduction on the subject of particle collisions, a study is made of tunneling and of its detection by computer and by experience (ion-penetration in solids, energy spectra of tunneled ions...). This literature survey describes also blocking, the effects of tunneling on the yield of nuclear reactions, and the investigational possibilities of tunneling in the field metallurgical research. Author (ESRO)

N68-31360# Picatinny Arsenal, Dover, N. J. Engineering Sciences Lab.
A FEASIBILITY STUDY OF THE APPLICATION OF AMORPHOUS SEMICONDUCTORS TO RADIATION HARDENING OF ELECTRONIC SYSTEMS
E. J. Evans Jun. 1968 101 p refs
(PA-TR-3698; AD-670949)

A significantly new approach to radiation hardening of electronic systems is currently being investigated. This new approach involves the application of amorphous (glass) semiconductors. These materials can provide active electronic devices which perform a switching function, and are inherently radiation hard. Through the application of this technology, military electronics potentially can be developed which will function during a nuclear blast and the associated transient effects, and survive to operate after much higher doses than would be possible using conventional transistor electronics. The report discusses the amorphous semiconductor technology in the light of the current state-of-the-art as well as the future potential. Specific topics included are: A brief description of the electronic processes; circuit applications and design examples; and long range impact of the amorphous semiconductor technology on radiation-hardened electronics. Author (TAB)

N68-31366# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THERMAL RADIATION IN METALS AND ITS RELATION TO THEIR OPTICAL AND ELECTRICAL PROPERTIES
C. Feldman and J. Reichman Aug. 1968 50 p refs
(RE-335)

A review is given of the theory of the radiative properties of metals in relation to their optical and electrical properties. Equations are developed for determining spectral, angular, and integrated emissivity in terms of the optical and electrical parameters. The effects of surface roughness and contamination are discussed, as are the spectral and temperature dependence of emissivity, in terms of Drude theory. A detailed treatment of the theory of the optical constants is presented that uses Maxwell's and the Boltzmann equations. The effects of the surface layer structure are taken into account, and interband transitions and the anomalous skin effect are described. The appendices give physical constants, conversion factors, etc., useful for calculating radiative properties. A numerical example is worked out to illustrate the use of the various equations. Author

N68-31389*# Hughes Research Labs., Malibu, Calif.
ELECTRONIC CONDUCTION IN ORGANIC MATERIALS Interim Final Report, 9 May 1966–9 Jul. 1967
R. J. Andres and R. Kikuchi 9 Jul. 1967 36 p refs
(Contract NAS7-468)
(NASA-CR-95960) CFSTI: HC$3.00/MF$0.65 CSCL 20L

A model has been proposed to explain differences in conductivity observed in diamides having both unsaturated and saturated carbon chains joining their amide groups. The absolute differences in electronic behavior cannot be established with certainty because of the yet unknown influence of crystal orientation, structural defects, and irregularity in crystal form. However, two definite and consistent differences between saturated and unsaturated amides appears to exist. These are: (1) electrical conductivity of the unsturated amides is several orders of magnitude greater than saturated amides having equivalent chain length; and (2) conductivity due to photoelectric processes increases in the unsaturated, but decreases in the saturated amides. Author

N68-31416*# Stanford Univ., Calif. Solid-State Electronics Lab.
FUNDAMENTAL STUDIES OF THE METALLURGICAL ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE Quaterly Progress Report, 1 Apr.–30 Jun. 1968
Gerald L. Pearson 30 Jun. 1968 14 p refs
(Grant NsG-555)
(NASA-CR-95950) CFSTI: HC$3.00/MF$0.65 CSCL 20L

The results of several studies on the various properties of gallium phosphides are summarized. The preparation and characterization of rectifying junctions in GaP and $GaAs_xP_{1-x}$ was studied with emphasis placed on relating the structure of the crystals to the electrical properties of the junctions. The variation of p-n junction depth with diffusion time for zinc diffusion into gallium phosphide discussed along with the construction of a vertical liquid epitaxial system. In a continuing effort to prepare power rectifiers and solar batteries which will operate at temperatures up to 500°C, the current-voltage characteristics of metal n-GaP Schottky barrier diodes were analyzed. Photoelectric responses were also measured. The behavior of shallow donors in gallium phosphide was examined by diffusing selenide, sulfur, and telluride into gallium phosphate. The diffusion of sulfur in GaAs, the variation of diffusion coefficient with arsenic pressure, and the variation of surface concentration with sulfur pressure were also investigated. B.S.D.

N68-31504# Washington Univ., Seattle. Dept. of Electrical Engineering.
ELECTROMAGNETIC SCATTER FROM SMALL DIELECTRIC GRADIENTS IN A CONTINUOUS MEDIUM
Richard Raymond Weiss, H. Myron Swarm, and Donald K. Reynolds May 1968 130 p refs
(Grant NSF GA-384)
(TR-120)

An investigation was conducted to find a method of evaluating the effect of small, smooth quasi-periodic anomalies in dielectric occurring in a continuous transmission medium. The problem is approached by considering the mathmatics of periodic structures in such a way that it can be applied to smooth, only slightly perturbed media. A review of plane wave solutions and a restatement of Floquet's theorem are discussed in terms that emphasize its relation to the investigation. Brillouin's perturbation procedure is used and certain properties of the resulting solutions are noted. An independent mathematical technique is applied with results that

closely substantiate the conclusions of the Brillouin method. Coaxial transmission lines with small perturbations were constructed and tested in the laboratory to create a controlled medium which verified one-dimensional and working lumped equivalent model for a truncated periodic structure. The one-dimensional theory periodic scattering analysis was extended to first-order multidimensional vector equations. B.S.D.

N68-31555# Forsvarets Forskningsanstalt, Stockholm (Sweden).
LATTICE SYMMETRY CORRECTIONS TO ENERGY-BANDS FROM A SPHERICAL MODEL. 1: THEORY
G. Arbman Apr. 1968 37 p refs
(FOA-4-C-4352-23)

A procedure is presented to impose symmetry corrections on the energy bands obtained from a spherical version of the cellular method. The mathematical basis is an earlier described variational principle. Wave functions obtained from the spherical model are utilized in the variational functional. Particular attention is paid to simple cubic, face-centered-cubic, and body-centered-cubic structures. Author (NSA)

N68-31589# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
g-FACTOR OF THE 656 keV STATE IN Cd 110
L. Keszthelyi, I. Demeter, I. Dezsi, and L. Varga 22 Apr. 1968 3 p refs
(KFKI-11/1968)

The g-factor of the first 2+ excited state of 110Cd was measured by observing angular correlations of the 1504-656 keV and the 1384/885/-656 keV cascades simultaneously. The internal magnetic field method was used; 110mAg was diffused into an Fe lattice. NSA

N68-31654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIELECTRIC PROPERTIES OF THIN FILMS OF PRASEODYMIUM, CERIUM AND NEODYMIUM FLUORIDES [O DIELEKTRICHESKIKH SVOYSTVAKH TONKIKH PLENOK FTORISTOGO PRAZEODIMA, TSERIYA I NEODIMA]
K. P. Bertulis and V. B. Tolutis 28 Sep. 1967 11 p refs Transl. into ENGLISH from Lietuvos Fiz. Rinkinys, Lietuvos TSR Mokslu Akad., Lietuvos TSR Aukstosios Mokyklos (Vilnyus), v. 5, no. 3, 1965 p 387–393
(FTD-HT-23-507-67; AD-670897)

The results are presented of an investigation of both the effective dielectric constants (epsilon sub ef) and dielectric losses of thin films of praseodymium (PrF3), cerium (CeF3), and neodymium (NdF3) fluorides. It was shown that the large values of epsilon sub ef and the dependence of dielectric losses on temperature and frequency may be explained by the presence of the barrier layers under the electrodes. The effective impurity-activation energies were determined to be: for PrF3 0.5-0.6 ev, for NdF3 and CeF3 0.8-1.1 ev. The value of the forbidden band of CeF3, determined from the absorption measurements, is 4.85 ev, while the values for PrF3 and NdF3 seem to be close to 5.9-6.4 ev. The process of aging of epsilon sub ef was investigated, and the dependence of the breakdown field was determined according to the thickness of the films. Author (TAB)

N68-31680# California Univ., Los Angeles. Dept. of Physics.
OPTICAL DETECTION OF SPIN LATTICE RELAXATION IN ND-LAES AND CROSS-RELAXATION IN ND-CEES
John Joseph Wooldridge Aug. 1967 157 p refs
(Grants NFS GE-6845; NSF GP-5379; NSF GP-1906)

A weak optical absorption line has been used to measure the spin lattice relaxation times of natural Nd and Nd–142 doped into lanthanum ethyl-sulfate. The measurements were carried out at a microwave pump frequency of approximately 23 kMc with the applied magnetic field parallel to the three fold symmetry axis of the crystal. Measurements within the temperature range 1.28 to 2.15°K show a bottlenecked relaxation rate for 3 percent Nd-142. Some new coupled rate equations, which describe the phonon flux and the spin system, are solved to obtain the effective relaxation time of the spin system. A direct observation of cross-relaxation between Nd-142 and Ce in Nd doped cerium ethyl-sulfate was carried out by optically monitoring the Nd spin population while pumping on Ce with microwave radiation. These measurements were performed within the temperature range 1.28°K to 2.14°K. The Nd resonance was also pup pumped directly with microwave radiation within the same temperature range and at 4.24°K. The microwave frequency was approximately 23 kMc and the magnetic field was parallel to the three fold axis. Author

N68-31786# National Research Council of Canada, Ottawa (Ontario).
ELECTRON SPIN RESONANCE IN ALKALI HALIDE CRYSTALS CONTAINING SULPHUR AND SELENIUM [ELEKTRONENSPIN-RESONANZ IN ACKALIHALOGENID-KRISTALLEN MIT SCHWEFEL- UND SELENZUSATEN]
A. Hausmann 1968 16 p refs Transl. into ENGLISH from Z. Physik (GERMANY), v. 192, no. 3, 1966 p 313–328
(NRC-TT-1311) CFSTI: HC$3.00/MF$0.65

The ESR of KCL and KBr single crystals doped with KSH or KSeH is investigated at low temperature. In these crystals interstitial hydrogen atoms are produced by irradiation with ultraviolet light at 20°K. After annealing to 110°K for some seconds and recooling to 20°K, the crystals show the resonance spectra of sulphur and selenium centres which are ascribed to S^-, H_2S^-, and Se^- ions. For verifying the nature of the centres crystals with KSD as well as KSH, the sulphur being enriched by S^{33} isotope, are studied. The components of the g and A tensors are determined. Two new types of sulphur centres are found in sulphide-doped crystals after introduction of F centres followed by irradiation with ultraviolet light at 370°K. Furthermore all crystals being investigated reveal the ESR of HCN^- ions. Author

N68-31802# National Research Council of Canada, Ottawa (Ontario).
STATES OF VIBRATION AND OPTICAL PROPERTIES OF MOLECULAR CRYSTALS [SCHWINGUNGSZUSTANDE UND OPTISCHE EIGENSCHAFTEN VON MOLEKELKRISTALLEN]
Gerhard Schaack 1968 16 p refs Transl. into ENGLISH from Physik Kondensierten Materie (GERMANY), v. 1, no. 3, 1963 p 232–244
(NRC-TT-1313) CFSTI: HC$3.00/MF$0.65

A discussion of the Born-Huang theory of dispersion with specific reference to internal vibrations in molecular crystals (organic crystals, ionic crystals with complex ions) connects part (ϵ'') of the optical dielectric tensor (ϵ) = (ϵ') – i(ϵ'') with the eigenfrequencies of the vibrations active in absorption and with the direction and magnitude of the transition moments in crystals. The limits are shown, within which this theory gives a Lorentzian line shape, often found in experiment. The propagation of an electromagnetic wave in a strongly absorbing, anisotropic medium and its reflection at crystal boundaries are investigated with special emphasis on the experimental determination of (ϵ). This treatment leads to expressions for (ϵ), which are not limited to the case of weak absorption and which are valid for all crystal symmetries. Author

N68-31825# Oregon State Univ., Corvallis.
ELECTRICAL PROPERTIES OF VANADIUM PENTOXIDE
John C. McCulloch 27 May 1968 53 p refs
(Contract Nonr-1286(08))
(TR-3; AD-670560)

The dc conductivity of single crystals of vanadium pentoxide was measured in the three crystallographic directions. The temperature range examined was −165°C to +25°C. The activation energy of the conduction process was isotropic and found to be .56 eV. The conductivity was anisotropic. Measurements of the Hall effect were attempted with a dc and ac apparatus, but the signal was too low to be observed. However, an upper limit of 71 Cu cm/Coulomb for the Hall coefficient was calculated, and the upper limit computed for the mobility was .4 sq cm/volt sec. A model is proposed for the conduction mechanism. It suggests that the electrical conduction is a two-step process. The electron is ionized from A V(4+)-oxygen-vacancy center and then moves through the lattice via polaron movement. This model accounts for the isotropy of the activation energy and also the anisotropy of the conductivity. Author (TAB)

N68-31858# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
[THE EFFECT OF HYDROSTATIC PRESSURE ON THE PROPERTIES OF SEMICONDUCTORS] Final Report, 1 Sep. 1966–31 Aug. 1967
Harvey Brooks and William Paul May 1968 44 p refs
(Contract Nonr-1866(10))
(HP-23; AD-670611)

The report gives a general description of research on the effect of hydrostatic pressure on the properties of semiconductors carried out over a ten-year period. It contains a complete bibliography of publications, a list of graduate students awarded the Ph. D. degree, and brief resumes of their theses which were issued as earlier Technical Reports in the series. Author (TAB)

N68-31919# Ecole Normale Superieure, Paris (France). Laboratoire de Physique.
MAGNETOPLASMA EFFECTS IN SOLIDS Final Scientific Report
J. Bok 30 Apr. 1968 18 p In ENGLISH and FRENCH Submitted for publication
(Grant AF-EOAR-65-45)
(AFOSR-68-1349; AD-670892)

Experiments on cyclotron resonance performed with a submillimeter spectrometer are discussed. These experiments were developed on tellurium and on metals (the later in the Azbel-Kaner configuration). They allowed: (1) to measure the mass constants of the ellipsoids of the valence band of tellurium; (2) to show the existence of secondary lines of cyclotron resonance in tellurium at very high frequency; (3) to verify the theoretical shape of the absorption line in copper and gallium, hence to measure directly the relaxation time. Author (TAB)

N68-31954# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics.
ENERGY LEVEL SCHEME FOR NP 4 PLUS IN LEAD MOLYBDATE
Kailash Kumar Sharma 20 May 1968 169 p refs
(Contract DA-31-124-ARO(D)-372)
(AROD-5738.1-P; AD-670983)

Np-doped (Na-charge compensated) crystals of PbMoO4 were grown by the Czochralski method. The absorption spectrum between 5000 and 25,000/cm and the fluorescent spectrum between 4000 and 7000/cm were obtained. The free-ion parameters obtained from a least squares fit to the five lowest free ion levels neglecting configuration mixing are E(1) = 2970/cm; E(2) = 14.01/cm; E(3) =312.1/cm and xi5f = 2089.2/cm. The r.m.s. deviation for this fit was 22/cm. A first order field perturbation calculation was also carried out. TAB

N68-31967# Rome Univ. (Italy). Istituto di Fisica.
MAGNETIZATION IN SUPERCONDUCTING FILMS
C. Di Castro, P. Tombesi, and W. Young (Rice Univ.) 13 Feb. 1968 23 p Refs *Its* Note No. 159
(NP-17482)

The magnetization as a function of the magnetic field was studied for films of thickness l much less than the coherence distance Ξ. The framework used is the pairing model with specular boundary conditions. For sufficiently low temperature and not-too-thin film the magnetization as a function of the magnetic field is shown to have a metastable branch corresponding to a similar branch in the order parameter Δ. A first-order phase transition is present in this case. At higher temperature or thinner films the magnetization is single-valued and goes continuously to zero. A second-order phase transition occurs. The critical field behaves like $l^{-5/2}$ for very thin films $[l < a(\Xi/K_F)^{1/2}]$ and like $l^{-3/2}$ for thicker films $[l \geq a(\Xi/K_F)^{1/2}]$. The weak field susceptibility in the first case has an l^3 dependence whereas there is an l^6 dependence in the second case. The results appear to agree with available experimental results. Author (NSA)

N68-32070# University of Southern Calif., Los Angeles. Dept. of Materials Science.
LOCAL MODE STUDIES OF LITHIUM-DEFECT COMPLEXES IN GALIUM ARSENIDE AND BORON-PHOSPHORUS PAIRS IN SILICON Final Report, 1 Dec. 1966–29 Feb. 1968
William G. Spitzer, Worth P. Allred, Miguel E. Levy, Orval G. Lorimor, and Victor P. Tsvetov Apr. 1968 43 p refs
(Contract F19628-67-C-0141)
(USCEE-282; AFCRL-68-0196; AD-670867)

Li-defect complexes in GaAs and B-P pairs in Si have been studied through infrared absorption spectroscopy of the associated localized vibrational modes. In Si, two infrared absorption bands attributed to B-P pairs are observed close to the isolated B band. The results are compared to the theory of Elliott and Pfeuty, and the number of pair bands, their isotope shift, and their proximity to the isolated B band are in general agreement with theory. In GaAs, bands observed after Li diffusion are identified with complexes of Li and native defects created during the diffusion process. The diffusion temperature dependence of the absorption band peaks obeys an effective activation energy expression (e exp. -E/kT), with E = 1.0eV. At least four defect complex species are present. Isotope mixture experiments show that at least one complex species contains more than one Li atom per complex. Author (TAB)

N68-32112# Idaho Nuclear Corp., Idaho Falls National Reactor Testing Station.
PHONON DISPERSION RELATION OF BERYLLIUM OXIDE
G. L. Ostheller, R. E. Schmunk, and R. J. Kearney May 1968 30 p refs
(Contract AT(10-1)-1230)
(IN-1129) CFSTI: HC $3.00/MF $0.65

The phonon dispersion relation measurements for BeO have been extended by neutron inelastic scattering, using the MTR tripleaxis spectrometer. New data include a transverse acoustic branch and an optical branch with wave propagation in the [01$\bar{1}$0] direction and in addition the transverse acoustic and a transverse optic branch, all with wave propagation in the [0001] direction. The two optical branches observed are degenerate at the center of the Brillouin zone with a frequency $\omega = 6.21 \pm 0.11 \times 10^{13}$ rad sec^{-1}. This frequency is in fair agreement with the optical data of Loh which gives $\omega = 6.41 \times 10^{13}$ rad sec^{-1} for the same mode. From the neutron-scattering data of this experiment and the optical data of Loh it appears that the low-lying optical branches reported previously by Brugger et al., are not single-phonon data, but are the result of multiphonon processes. Comparison is made between the measured branches of the dispersion relation and the results of preliminary lattice dynamics model calculations. Author (NSA)

N68-32177 Institute of Nuclear Research, Warsaw (Poland).
SIMPLE DEFECTS IN GERMANIUM CREATED BY HIGH ENERGY ELECTRONS [DEFEKTY PROSTE W GERNAMIE WYTWARZANE ELEKTRONAMI WYSOKOENERGETYCZNYMI]
Henryk Rzewuski 1968 79 p refs In POLISH; ENGLISH Summary
(Rept.-890/II/PS) CFSTI: $3.00

The properties of simple defects in crystal lattice of n-type germanium created by 1 MeV electrons from the Van de Graaff electrostatic accelerators using D.C. and pulsed beams were investigated. The measurements were carried out in the temperature range from 80°K to about 200°K. It was evidenced for antimory doped germanium that in the temperature range from 100°K to 120°K the fast annealing process of metastable defects is taking place. Taking the obtained results into account the new model of metastable defect based on the properties of double-charged center was propesed and discussed. Studying the charge state of simple defects with the method of isochronal annealing of Hall mobility the two, new annealing thresholds at T_1 = 100°K and T_2 = 140°K were observed Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-31263 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany).
INVESTIGATIONS ON THE FEASIBILITY OF GASEOUSLY STORED PROPELLANTS FOR CONTROL ROCKET SYSTEMS [BETRACHTUNGEN ZUR VERWENDUNG GASFOERMIG GESPEICHERTER TREIBSTOFFE FUER LAGEREGELUNGSRAKETENTRIEBWERKE]
W. Buschulte Bundesministerium fuer Wiss. Forsch. Apr. 1968 23 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-68-25) CFSTI: $3.00

The feasibility of using stored gaseous propellants for controlling satellites and space probes by microrockets was studied assuming ideal thermodynamic behavior of the gases. Conditions and requirements for gaseous propellants or propellant systems are established for this task. A comparative evaluation is made of weight and performance of attitude control systems for gaseous and liquid propulsion systems. Author

N68-31729*# Union Carbide Corp., Bound Brook, N. J. Polymer Research and Development.
SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAIN
James E. Potts, ed. 20 Apr. 1968 28 p Prepared for JPL
(Contracts NAS7-100; JPL-951210)
(NASA-CR-96133) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The continuous stirred autoclave reactor system has been modified by the addition of automated pressure controls. The reactor itself has been replaced by another with a higher pressure rating. The new system can operate effectively at 35,000 psi. A melt process employing no solvent and using potassium hydroxide dispersed at 300°C in the polymer melt has been found to give rapid and quantitative elimination of HBr from ethylene/neohexene telomers with a minimum of rearrangement to vinylidene type C=C. Processes using solvents were either not as fast, gave a large amount of rearranged product or both. A new series of telomers has been prepared, this group having ethylene and propylene as comonomers and having $BrCCl_3$, α-bromo isobutyric acid and its *t*-butyl ester as the telogens. A combination of low viscosity and very low penetration temperature make these telomers very attractive as solid propellant binder precursors. Author

N68-31872# Falcon Research and Development Co., Denver, Colo.
A VULNERABILITY EVALUATION OF EMULSIFIED FUELS FOR USE IN ARMY AIRCRAFT Final Report, 1 Jan.–31 Dec. 1967
George H. Custard Apr. 1968 172 p
(Contract DA-44-177-AMC-415(T))
(Rept.-6204-2-F; USAAVLABS-TR-68-20; AD-670935)

The evaluation of emulsified JP-4 concentrated upon the fuel properties which relate to the ignition and propagation of fire under the conditions of ballistic attack and survivable aircraft accidents. The specific areas of study and testing include the following: (1) fuel combustion rates as a function of air velocity and air temperature, (2) fuel vaporization rates under closed-tank and vented-tank conditions, (3) fuel permeability, (4) fuel dispersion characteristics under conditions of high-velocity ballistic impact and spillage from heights to 20 feet, (5) ease of fuel droplet or spray ignition with various energy sources, (6) fuel and tank panel behavior when hit by functioned incendiary bullets, (7) fire extinguishing ease with a variety of extinguishants against a standardized fire, and (8) self-sealing panel performance with fuel emulsions. It was concluded that emulsified fuels offer opportunities for greater aircraft survivability from several standpoints. They may be employed most advantageously as a part of a total passive defense system for aircraft fuel. Author (TAB)

N68-32014# Stanford Research Inst., Menlo Park, Calif. Poulter Labs.
RESPONSE OF A BURNING PROPELLANT SURFACE TO EROSIVE TRANSIENTS Final Report
G. A. Marxman, C. E. Wooldridge, and E. L. Capener 30 Apr. 1968 133 p refs
(Contract AF 49(638)-1665)
(AFOSR-68-0771; AD-670525)

The report describes an investigation of high-amplitude axial-mode solid rocket combustion instability which arises in the form of an oscillating shock wave in the combustion chamber. Experimental studies have provided an evaluation of the influence of compositional factors, oxidizer type, and deflagration characteristics on the incidence of axial instability. The stability characteristics of a wide range of ammonium perchlorate and potassium perchlorate propellants were determined in motors ranging from 15 to 82 in. in length, using an explosive pulse to initiate a traveling shock wave. Differential thermal analysis of these propellants, and experiments incorporating fiber-optic devices with high-speed photography, indicated that surface-coupled heat release is a key factor underlying the different stability behavior observed with various propellants. A theoretical combustion model was proposed and a mathematical analysis was developed that predicts the response of a burning propellant to the pressure pulse imposed by a traveling shock wave as it passes over the propellant surface. Also considered theoretically was the interaction mechanism through which this burning rate response supports the shock wave. The resulting theory predicts the limits of the stable operating regime for individual propellants in terms of thermochemical parameters and the degree of surface-coupled heat release associated with the propellant type. The theory provides a consistent explanation of all stability characteristics observed experimentally during this program and established guidelines for avoiding axial instability. Author (TAB)

N68-32077# Pennsylvania State Univ., University Park. Ordnance Research Lab.
DECOMPOSITION CHARACTERISTICS OF NITRITE ESTER MONOPROPELLANTS

G. A. Yanyecic 17 Jan. 1968 100 p refs
(Contract NOw-65-0123-d)
(TM-705.9161-03; AD-670731)

A theoretical and experimental investigation was made of the combustion characteristics of nitrate ester droplets, including propylene glycol dinitrate, ethyl nitrate and n-propyl nitrate, at various ambient gas temperatures and pressures. Measurements were made of droplet diameter and temperature during combustion. At high pressures, the droplet ignited early in its heat-up period at a more or less fixed liquid temperature. At low pressures, the droplet ignited as its temperature approached the wet bulb temperature. A simplified theoretical model was found to give an adequate correlation of the ignition time in both regimes. A combustion model was formulated in studying the burning rates of the droplets. The model includes the effect of conviction on the burning rate. This model was found to be in fair agreement with the data. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-30947# Brussels Univ. (Belgium). Aeronautical Inst.
PERIPHERAL JET AIR CUSHION ENERGY STUDY OF HYBRID PROPULSION. 2 [VEHICULE A COUSSIN D'AIR A JET PERIPHERIQUE. ETUDE ENERGETIQUE DE LA PROPULSION MIXTE, 2]
A. Jaumotte, A. Kiedrzynski, and G. Van de Steen 1967 43 p refs In FRENCH
(Contract DRME-79/65)
(Rept.-4) CFSTI: HC $3.00/MF $0.65

In the case considered, attention was focused on a peripheral jet aeroglider with hybrid propulsion, where the necessary thrust is furnished by an aerial helix and by the reaction provoked by the deviation of a part of the jet in the opposite direction to the motion. This deviation is obtained by blades placed in the rectilinear part of the peripheral slot. The dimensions of the base surface and the peripheral slot are determined along with the characteristics of the fan. Calculations are made of the minimum power equipment for the total weight, flight speed and altitude, and the angle of jet deviation, and the maximum coefficients for the total power equipment, the total weight, flight speed and altitude, and angle of deviation. A comparison is drawn between a vehicle with hybrid propulsion and one propelled by an aerial helix alone. The gain in performance obtained by using hybrid propulsion is found to be on the order of 3.5% as compared with propulsion by the aerial helix. Transl. by M.G.J.

N68-30962# Sud-Aviation, Paris (France).
SOLID PROPELLANT ROCKETS [LES FUSEES A POUDRE]
J. de Montravel Mar. 1967 57 p In FRENCH Presented at the School on the Technol. of Space Expt., 8 Mar. 1967 Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Solid propellant rockets are reviewed. The composition of the rocket is given and problems of combustion and ignition are dealt with. As examples Dragon third stage and Belier, Centaure, Dragon sounding rockets are described. A composition is made between solid propellant and liquid propellant rockets. ESRO

N68-31117*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AN INVESTIGATION OF FLUORINE-HYDROGEN MAIN TANK INJECTION PRESSURIZATION Final Report, 31 Jul. 1967–30 Apr. 1968
E. C. Cady 30 Apr. 1968 97 p refs
(Contract NAS3-7963)
(NASA-CR-72408; DAC-62233) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental program is described that determined the feasibility and operating characteristics of Main Tank Injection of a LH_2 tank with F_2. A small-scale test program determined hypergolicity limits and is reported in an interim report. The large-scale test program to evaluate four and to design and test three F_2 injectors is described. Both pressurization and LH_2 expulsion were performed with a 105-gallon high-pressure LH_2 tank. The injector efficiency, design criteria, and performance limitations were determined. Reliable ignition, effective tank pressure control, and feasibility of the F_2-H_2 MTI pressurization technique were demonstrated. Author

N68-31120# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
PROJECT SQUID SEMIANNUAL PROGRESS REPORT, 1 OCTOBER 1967–31 MARCH 1968
1 May 1968 76 p refs
(Contract N00014-67-A-0226-0005; Proj. Squid)
(AD-670538)

Reports of progress during the past six months on 14 of the 15 research programs comprising Project SQUID are presented. The research programs fall into the areas of Fluid Mechanics and MHD, Atomic and Molecular Collisions, Combustion and Chemical Rate Processes, and Chemi-Ionization and Ion-Molecule Reactions. Project SQUID is a cooperative program of basic research related to jet propulsion. Author (TAB)

N68-31251# Aeronautical Research Council (Gt. Brit.).
MEASUREMENTS OF THE PERFORMANCE OF A TURBO-JET ENGINE WITH REHEAT (ROLLS ROYCE RA28R AVON) IN HIGH SPEED FLIGHT AND UNDER SIMULATED CONDITIONS IN TEST BEDS
A. A. Woodfield, Ann Cronin, and Glynis Vorley 1968 71 p refs Supersedes RAE-TR-66060, ARC-27873
(ARC-R&M-3538; PD-3456; RAE-TR-66060; ARC-27873; AD-833473) CFSTI: HC $3.00/MF $0.65

The performance of a turbo-jet engine has been measured, and alternative methods of determining gross thrust and air mass flow calibrated in a ground level static test bed and an altitude test bed simulating flight conditions. The agreement between the two test beds is very good. It is shown that if it is necessary to extrapolate calibrations to flight conditions, this may be made most accurately in terms of effective areas. The preferred method of measuring gross thrust in flight is that based on the final nozzle static pressure measurements. The measurements of air mass flow required to convert gross thrust to net thrust are subject to quite large random errors, but the method based on the measurements from the transition section between the turbine and jet pipe is easiest to apply, and it should be possible to improve its accuracy. Using these methods, random errors of the order + or - 4 per cent for net thrust determination can be expected. Comparison of non-dimensional performance measured in flight, and in the test beds, was good for non-reheat conditions, but significant differences were noted for the reheat results. It is believed that these differences were due to the effects of the intake on the reheat fuel control unit in flight. The accuracy of net thrust in flight determined by the non-dimensional method is of the same order as that based on the detailed calibrations for the non-reheat conditions, but would have a systematic error of 10 per cent for reheat conditions. Author (TAB)

N68-31305*# Thiokol Chemical Corp., Huntsville, Ala.
THEORETICAL STUDY OF THE BALLISTICS AND HEAT TRANSFER IN SPINNING SOLID PROPELLANT ROCKET MOTORS
R. Harold Whitesides, Jr. and B. Keith Hodge Aug. 1968 170 p
(Contract NAS1-7034)
(NASA-CR-66639; U-68-20A) CFSTI: HC $3.00/MF $0.65 CSCL 21B

This study consisted of an analytical investigation of the effects of spin-induced radial acceleration on (1) the ballistics of a motor with a circumferential slot, (2) the evolution of the burning surface, (3) the convective heat transfer to the nozzle and head-end dome, and (4) the burning rate of metallized and non-metallized propellants. Techniques and computer programs to predict the effects of the slot-port flow interaction implied that the spin effects on circumferential slot ballistics are secondary. A computerized technique for predicting the regression of an internal burning surface with radial acceleration effects showed that the specific effects of spin rate on surface regression are (1) the non-uniform surface evolution of star grains, (2) increasing motor pressures with spin rate, and (3) increasing progressiveness with spin rate of pressure–time histories for star grains. Two semi-empirical analyses and computer programs were developed that predict the convective heat transfer to the nozzle wall and to the headend dome of a spinning rocket motor. Author

N68-31316# Silverstein (Calvin C.), Baltimore, Md.
PRELIMINARY EVALUATION OF GAS TURBINE REGENERATORS EMPLOYING HEAT PIPES Final Technical Report
Calvin C. Silverstein Apr. 1968 112 p refs
(Contract DAAJ02-67-C-0053)
(USAAVLABS-TR-68-10; AD-671028)

A preliminary study of heat pipe gas turbine regenerators for future Army aircraft power plants was carried out, and a feasibility evaluation was made. Heat pipe regenerators appear to be technically feasible, and they can readily be integrated with gas turbines with a minimum of duct pressure losses and engine modification. Regenerator weight is comparable to or greater than that of other regenerator types. Considerable development can be anticipated for both individual heat pipes and regenerator core modules prior to completion of a successful prototype. Regenerator costs are expected to be high. Author (TAB)

N68-31405* Mathematical Applications Group, Inc., White Plains, N. Y.
NONLINEAR COMBUSTION IN STABILITY IN LIQUID-PROPELLANT ROCKET MOTORS Quarterly Report
Samuel Z. Burstein and Wallace Chinitz 30 Apr. 1968 74 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951946)
(NASA-CR-96014; QR-3) CFSTI $3.00 CSCL 21B

Numerical experiments were performed under both nonreacting and reacting flow conditions with a fluid dynamic pancake model of the combustor during the study of nonlinear combustion instability in liquid propellant rocket motors. Droplet evaporation and combustion analysis was also undertaken, and some results towards completing the Peskin—Wise model relating to the modified flame surface analysis are included. Fluid dynamic model studies considered the finite amplitude transverse waves in a cylindrical chamber as well as the energy release in a fluid with finite amplitude waves and simple energy source. Details are included for finite amplitude waves and simplified modified Godsave analysis. M.W.R.

N68-31457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A GENERALIZED HYDRODYNAMIC EQUATION TO DETERMINE THE TRACTIVE FORCE OF AN ISOLATED DIRECT REACTION ENGINE [OBOBSHCHENNOYE GIDRODINAMICHESKOYE URAVNENIE DLYA OPREDELENIYA SILY TYAGI IZOLIROVANNOGO DVIGATELYA PRYAMOY REAKTSII]
V. A. Bashkatov 13 Sep. 1967 17 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Sibirsk. Otd., Ser. Tekhn. Nauk (USSR), no. 2, 1966 p 3–11
(FTD-HT-23-511-67; AD-670816)

In the present study a generalized equation is presented which permits evaluation of axial thrust components in new types of reaction motors. Also given is an equation for the mean thrust for a pulsating engine using both the internal and external fluids. For a magnetohydrodynamic rocket engine with plasma acceleration in an electric or natural magnetic field, an equation is given for the axial thrust component. Author (TAB)

N68-31462# Technische Hochschule Stuttgart (West Germany).
LOSSES IN COMBUSTION CHAMBERS [VERLUSTE IN RAKETEN TRIEBWERKEN]
Lutz T. Kayser Jun. 1968 19 p In GERMAN; ENGLISH summary
(AGRR-TB-15) CFSTI: HC $3.00/MF $0.65

The efficiencies of characteristic velocity and thrust coefficient in rocket engine combustion chambers are discussed. The characteristic velocity efficiency is shown to be the dependent variable of a Bernoulli differential equation with the characteristic length as the independent variable. Author

N68-31476*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TURBOJET AND TURBOFAN CYCLE CONSIDERATIONS AND ENGINE CONFIGURATIONS FOR APPLICATION IN LIGHTWEIGHT AIRCRAFT
Richard J. Roelke and Warner L. Stewart Washington Aug. 1968 17 p ref
(NASA-TM-X-1624) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Engine studies were made to define cycle characteristics of small turbojet and turbofan engines for a selected set of lightweight aircraft flight requirements. From these cycle studies, representative engine conditions were selected and used as a basis for the examination of associated engine configurations. Emphasis was placed on the types of turbomachinery involved and their associated diameters. Author

N68-31513# British Aircraft Corp., Weybridge (England). Acoustics Lab.
THE ESTIMATION OF JET ENGINE NOISE
J. A. Hay 20 Feb. 1968 17 p refs
CFSTI: HC $3.00/MF $0.65

Principal areas where jet aircraft noise is a problem are outlined, and attention is given to some of the areas where improvements in noise estimation methods are urgently required. Air-to-ground noise and structural noise problems are treated, particularly in relation to the role of jet engine noise and the design and operation of aircraft. Shortcomings in methods of predicting both jet and fanjet noise are noted. M.W.R.

N68-31659# Naval Air Propulsion Test Center, Trenton, N. J. Aeronautical Turbine Dept.
EFFECT OF MIXING LENGTH ON ROTARY FLOW INDUCTORS
J. Lawrence Palcza Apr. 1968 32 p refs
(NAPTC-ATD-147; AD-670594)

A series of model tests were run using a variety of shroud configurations to determine the effect of primary-secondary flow mixing lengths on rotary nozzle ejectors. Maximum augmentation was achieved at mixing lengths of 3.5 to 4.0, whereas, non-rotating ejectors require mixing lengths of 6 to 10. Author (TAB)

N68-31659# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
INVESTIGATIONS ON THE FLOWFIELD AROUND A PYRAMID-SHAPED CENTRAL BODY OF ENGINE INLETS
N. Schmidt [1968] 145 p refs
(Rept.-1169)

A square pyramid may be used as a centerbody of a supersonic intake of variable geometry, which joins the advantage of a three-dimensional compressing cone and that of plane surfaces of a wedge. The flow field around the centerbody is the point of interest. Results of an extended slender body theory—extended by elements of the nonlinear cone flow theory—are given, especially the distribution of pressure and Machnumber in the flow field around the body, the pressure drag of the body, and the shape of the shock. These results are compared with experimental data from a pyramid with a 25° apex half angle at Machnumbers ranging from 2 to 3. Author

N68-31937*# Aerotherm Corp., Palo Alto, Calif.
STUDIES OF ABLATIVE MATERIAL PERFORMANCE FOR SOLID ROCKET NOZZLE APPLICATIONS
John W. Schaefer, Thomas J. Dahm, David A. Rodriguez, John J. Reese, Jr., and Mitchell R. Wool 1 Mar. 1968 176 p refs
(Contract NAS7-534)
(NASA-CR-72429: Rept.-68-30) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Analytical and experimental studies of ablative material performance for solid rocket nozzle applications were performed. Large scale computer codes were employed to calculate the ablation, thermal, and structural responses of the 260-SL-3 nozzle as a design check and as a basis for post-fire analysis. The calculated performance included consideration of surface chemical reactions, melt removal, particle deposition, char swelling, in-depth kinetic decomposition, and anisotropic mechanical and thermal properties. Laboratory tests were performed to determine and study the properties and performance mechanisms of three silica phenolic materials. In performing these tests, an arc plasma generator was used to simulate the solid rocket nozzle environment and a two-dimensional nozzle was used to simulate a large ablative part. The results included the definition of the surface melt removal characteristics and the thermal conductivity of the charring material to 5,000°R for 0° and 90° layup angles. Ablative and thermal performance calculations were also performed for the nozzle of an upper-stage restartable beryllium propellant motor. Author

N68-31939*# Aerojet-General Corp., Sacramento, Calif.
COATINGS FOR REGENERATIVE ENGINES Final Report
W. J. Lewis 12 Jul. 1968 97 p refs
(Contract NAS3-7955)
(NASA-CR-72413; Rept.-28238T; FR-1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Thermal barriers are under development to reduce the heat flux to the coolant for a 5000-lb-thrust flox/propane regeneratively cooled chamber. An analysis was conducted to establish thermal and chemical environment for the thermal barriers. Based on the thermal and chemical environment and material properties W, Mo, Al_2O_3, and ZrO_2 were selected for the basic thermal barrier materials. Screening tests were made on the coatings in the laboratory using a plasma torch to simulate the thermal environment but not the chemical environment of the flox/propane engine. The final tests consisted of exposing coated 5-tube specimens to the exhaust stream of a flox/propane rocket engine. Severe regression was obtained on the graphite shield (used to protect specimen water inlets) indicating that air entrainment occurred. This would make the chemical environment more severe than originally analyzed. The regression rate of the coatings exposed to the flox/propane environment varied with coating composition. The lowest regression rates occurred in coatings with flame liners containing 100% Mo, W, or ZrC/C. The regression rates for these flame liners were 0.4 mils/sec, which is relatively high for thermal barrier systems. Author

N68-32048*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN INVESTIGATION OF SPHERICAL BLAST WAVES AND DETONATION WAVES IN A ROCKET COMBUSTION CHAMBER
John M. Bonnell 15 Aug. 1968 21 p refs
(Contract NAS7-100)
(NASA-CR-96158; JPL-TR-32-1286) CFSTI: HC $3.00/MF $0.65 CSCL 21B

An investigation was conducted to determine the nature of the shock-like wave produced by an explosion in a liquid propellant rocket combustion chamber. A relatively simple model of the wave behavior was devised. It consisted of a spherical blast wave that developed into a steadily propagating Chapman Jougue plane detonation wave. The behavior of the blast wave close to the explosive source was determined by a series of bomb tests conducted in a chamber pressurized with nitrogen. The behavior of a spherical wave in a reacting medium was determined by exploding bombs mounted on the axial centerline of a rocket combustor in a series of rocket motor firings. A comparison of the theoretical and actual times for a wave to travel from its source to the chamber wall indicated that the actual times were appreciably larger. However, the theoretical detonation conditions of the combustion chamber were rather ill-defined and could be adjusted to accommodate the experimental results. The results indicated that the bomb-generated wave, on its first pass to the wall, behaved more like a blast wave than a detonation wave. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-31001 California Univ., San Diego.
PART 1 HIGH TEMPERATURE EQUILIBRIA AND CONDENSATION. PART 2: SOLAR WIND INTERACTION WITH SOLIDS
Harry Chester Lord, III (Ph.D. Thesis) 1967 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-12857

This is a study of the molecular equilibria present in a gas cloud with cosmic elemental abundances, temperatures of 2000°K or 1700°K, and total pressures of approximately 1 atm. and 5×10^{-4} atm. with special consideration of the formation of a condensed phase. It is shown that in the atmospheres of cool stars polyatomic molecules and possibly condensed species play an important role. Using the technique of flash heating to produce the vapor phase, condensation in simple systems is studied. Vaporization of iron has given a supersaturated vapor which condensed as small spherules ($\leq$1000 Å diameter). To simulate the effects of the solar wind, olivine has been irradiated with 2 keV protons, and olivine, dunite, enstatite, and fayalite have been irradiated with 1.8 keV He ions. X-ray diffraction analysis, electron probe microanalysis, microscopic analysis, and studies of the characteristic X-rays

produced by low energy protons, have been performed on the bombarded surfaces. Only the last technique detected elemental composition changes. Dissert. Abstr.

N68-31352*# LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
ANALYSIS OF POLAR CAP ABSORPTION EVENT 5 RF PROFILES, ACTIVE SOLAR REGIONS AND ASSOCIATED PHENOMENA, REQUIREMENTS FOR A PROTON WARNING SYSTEM
Fred. C. Jonah 13 Jun. 1968 99 p refs
(Contract NAS9-7134)
(NASA-CR-92210; REPT.-00.1081) CFSTI: $3.00 CSCL 03B

Data, detailed analyses, and interpretations of related solar flare and terrestrial phenomena are presented. Solar flare patrol films from two solar observatories were used to compare multipeak RF emissions with possible multimaxima flares. Visual analysis of films did not produce desired accuracy, although the theory that brightness of flares are associated with multipeak or complex RF emissions was strengthened. The RF time histories were evaluated and classified, and correlated with Hα flares. This showed that if RF emissions with total integrated energy greater than 10^{-1} joules $(m2\ c/s)^{-1}$ were not followed by a known polar cap absorption (PCA) event, the flare had a slow and gradual rise to maximum intensity. A preliminary analysis of RF emission and Hα flare data from the 20th solar cycle is included. Investigation of flare position with respect to sunspot umbra and flares from sunspots with a δ configuration failed to yield any new statistical evidence concerning their importance to flare–PCA correlation. A bibliography is listed. The RF profiles with PCA and flare maxima are included. D.H.B.

N68-31415# Uppsala Univ. (Sweden). Cosmic Ray Group.
DAY TO DAY VARIABILITY OF THE DAILY VARIATION OF COSMIC RAYS DURING THE QUIET PERIOD OF THE SOLAR ACTIVITY
Byung-So Pak Apr. 1968 29 p refs
CFSTI: HC $3.00/MF $0.65

Calculation of the day to day variability of the daily variation of the cosmic ray intensity using high latitude neutron monitor data is described. Variances of time of maxima, minima and their differences were calculated for each solar rotation period, by superimposing first and second harmonics as well as by smoothing the values. Several factors which may effect the analysis have also been discussed. A considerable correlation was found between the variances of maxima and minima and the solar activity expressed in Zürich relative sunspot number. This was not revealed by long time averaged analyses. A negative correlation between the variances and averaged amplitudes over the period also appeared from the study. It was concluded that the daily variation may be characterized as follows: a) the Axford-Parker theory on the daily variation is consistent with the observations on some days, b) an azimuthal streaming could not manifest itself as a daily variation in the counting rate of the detectors, or the present analytical method is not sufficient to decide these physical quantities, c) a separate mechanism responsible for the time of minimum would be operating on some days and independent of the time of maximum, so the daily variation of the cosmic ray intensity can not be approximated by a diurnal variation. Author

N68-31506*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
SOLAR PARTICLE OBSERVATIONS FROM 24 JANUARY TO 24 FEBRUARY 1967
William G. Innanen (M.S. Thesis) Feb. 1968 100 p refs
(Contract NAS5-9076)
(NASA-CR-95984) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Solar particle observations were taken from Explorer 33 and Mariner 4 satellites. The detection apparatus consisted of Geiger–Mueller tubes and solid state surface barrier detectors. The time period observed is considered in three parts beginning 28 January, 1 February, and 13 February, 1967. Proton and electron flux level measurements are related to solar flare activity and the interplanetary magnetic field structure. Polar cap absorption data are also correlated with particle observations. The proton to alpha particle ratio was noted to remain relatively constant during the observed intensity variations except for two ratio maxima noted on 15–16 February. Counts/second versus time graphs present the observed data. D.H.B.

N68-31632*# Volt Technical Corp., Washington, D. C.
RADIAL DIFFUSION OF ELECTRONS WITH ENERGY GREATER THAN 100 KEV IN THE OUTER RADIATION BELT
S. N. Vernov, S. N. Kuznetsov, Yu. I. Logachev, G. B. Lopatina, E. N. Sosnovetz et al 2 Aug. 1968 13 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 3, 1968 p 401–411
(Contract NAS5-12487)
(NASA-CR-96125; ST-PF-10732) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The study carried out in 1964 on time variations of electrons with energies $E_e > 100$ kev in the outer radiation zone shows that variations in electron intensity on the drift shells close to the Earth are systematically lagging relative to variations in electrons on shells with high values of L. This retardation is due to the diffusion of electrons with $E_e > 100$ kev across the drift shells. The "retardation" time Δt between the variations in electron intensity on various L-shells was determined by the statistical method and for $L = 50$ and $L = 40$ was $\approx 5 \pm 1$ days. Under specific assumptions this results in a drift velocity $\overline{V} \approx 0.2$ Earth's radii per day for $L \approx 4.4$. In the $40 < L < 0.5$ range, the time and the drift velocity of electrons, measured by means of direct observation of the systematic displacement of the leading "wave" front of electrons with $E_e > 100$ keV and > 400 keV coincide within error limits with the results obtained by the correlation method. The diffusion velocity of electrons does not depend on the geomagnetic latitude. Author

N68-31651*# Volt Technical Corp., Washington, D. C.
QUASIPERIODICAL LOW-FREQUENCY FLUCTUATIONS OF SUN'S RADIOEMISSION
O. I. Yudin 13 Aug. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 180, no. 4, Jun. 1968 p 821–823
(Contract NAS5-12487)
(NASA-CR-96138; ST-SP-RA-10739) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The quasiperiodical low-frequency fluctuations of Sun's radioemission are studied on the basis of influence of weak chromospheric parameter fluctuations on the variations of Sun's radioemission flux. To that effect the quasi-zero registration method was applied in the 3.3 cm wavelength. The results obtained by the author corroborate the findings that its quasiperiodical modulation is conditioned by processes in the upper chromosphere. Author

N68-31684# Wisconsin Univ., Madison. Dept. of Soil Science.
AN INTEGRATING PYRANOMETER FOR CLIMATOLOGICAL OBSERVER STATIONS AND MESOSCALE NETWORKS Progress Report, 30 Sep. 1967
C. B. Tanner, J. P. Kerr, G. W. Thurtell, and H. Rosendal 30 Sep. 1967 157 p refs
(Grant CWB-WBG-49)
(PB-177740) CFSTI: HC $3.00/MF $0.65

The purpose of the study was to obtain information on the space and time variability of global radiation in Wisconsin. Estimates can be made from these data as to the distribution of sampling points required to get a reliable estimate of radiation received at any given place in the state. A secondary objective was to gather information on the performance of the integrating pyranometer under field conditions. Author (USGRDR)

N68-31860# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
ONE-DIMENSIONAL POLARIZATION DISTRIBUTIONS OVER FOUR SUPERNOVA REMNANTS AT 1418 MHz
G. A. Seielstad and K. W. Weiler 1968 28 p refs Submitted for publication
(AD-671151)

Distributions of the linearly polarized radiation at a frequency of 1418 MHz from the four supernova remnants 3C 10 (Tycho's supernova), taurus a (crab Nebula), 3C358 (Kepler's supernova), and Cassiopeia A have been determined by synthesizing a fan beam whose small dimension is along a circle of constant declination. In addition, extremely low upper limits have been placed on net degree of circular polarization in the integrated radiation from tau A, 3C358, and cas A. For the latter two sources, no smaller circularly polarized regions were found within the source dimensions using a resolution of better than 1'. Upper limits to the magnetic field strengths, modified by geometrical factors have also been calculated.
Author (TAB)

N68-32001# Polish Academy of Sciences, Warsaw.
STUDY OF THE CORRELATION BETWEEN ORBIT EVOLUTION AND SOLAR ACTIVITY
N. P. Slovokhotova *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 3–14 refs (See N68-32000 19-30)

The correlation between solar activity and the acceleration of four satellites (1957 Beta, 1958 δ 1, 1958 δ 2, and 1958 Epsilon) is examined. For this purpose, fields are plotted for the correlation between satellite accelerations $\dot{P}$ and characteristics of the solar activity (K_p indices and intensities S of solar 10.7-cm radiation). The $\dot{P}$-K_p correlation seems to be the more distinct, particularly when perigee is in the shadow. The correlation between $\dot{P}$ and S is almost unnoticeable. Author

N68-32059# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RADIO EMISSION FROM VENUS IN THE 4-MILLIMETER WAVELENGTH RANGE
A. G. Kislyakov, A. D. Kuzmin, and A. E. Salomonovich *In its* Astron. Papers Transl. from the Russian, Pt. 1 28 Nov. 1962 p 1–2 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz. (Gor'kiy), v. 4, 1961 p 573–574 (See N68-32058 19-30)

Observations of the radio emission from Venus in the 4 millimeter wavelength range were made by an optical guided telescope. Measurements were carried out for different altitudes of the axis of the optical guide and the antenna temperature was determined by either comparing the obtained signal with the radiation of an absorbing wedge in the signal path or by comparison with the atmosphere's own radiation. Evaluation of several recorded Venus passages through the beam of the radio telescope established the Venus temperature at about 390°K ± 120°K at a dispersion coefficient of ≈0.7 for the antenna outside the principal lobe. G.G.

N68-32060# Smithsonian Astrophysical Observatory, Cambridge, Mass.
INFLUENCE OF THE CHANGING MASS OF THE SUN ON ELECTROMAGNETIC AND CORPUSCULAR RADIATION PRESSURE
V. V. Radzievskii *In its* Astron. Papers transl. from the Russian, Pt. 1 28 Nov. 1962 p 3–6 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 81, no. 2, 1951 p 167–170 (See N68-32058 19-30)

Calculated is the complete absorption of both electromagnetic and corpuscular radiation from the sun by a spherical body of known mass, radius, and density that moves in a circular orbit around the sun. The effects of the secular decrease of the sun's mass is shown to cause an increase in the average distance of particles from the sun according to the law MR = constant, where M is the sun's mass and R the average distance of particles from the sun. As a result of absorbing solar radiation the specific angular momentum of a close planet decreases faster than the axial specific orbital momentum of the sun. G.G.

N68-32184# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information.
SPACE RADIATION
William R. Corliss Jun. 1968 63 p refs

Reported is a booklet on space radiation which is part of an educational series designated "Understanding the Atom". Contents include discussions of interplanetary weathermakers, the earth's snug harbor, space radiation instrument primer, tremors from without, the importance of more altitude, the great magnetic trap, beyond the great radiation belts, and safety aspects of space travel. A list of suggested references is also included. Single copies of any booklet in the series or complete sets of the series are available to school and public librarians, and to teachers. S.C.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-30890 Texas Univ., Austin.
HOMOGENEOUS DUST FILLED COSMOLOGICAL MODELS
David Leroy Farnsworth (Ph.D. Thesis) 1967 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-14825

The solutions of Einsteins gravitational field equations are found under the assumptions that the field is produced by noninteracting dust and that there exists a simply transitive four parametric group of motions. The group possesses structure constants which are presented by the affine tensor C^a_{bc}. The solutions with $C^a_{ba} \neq 0$ are well known. The solutions with $C^a_{ba} = 0$ are found in detail using tensor methods. The cosmological constant is found to be nonzero for both kinds of solutions. Dissert. Abstr.

N68-31057 California Univ., Los Angeles.
THE SOLAR ABUNDANCE OF LIGHT ELEMENTS
Bernard James O'Mara (Ph.D. Thesis) 1967 226 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-14319

The solar abundances of carbon, nitrogen, oxygen, sodium, magnesium, aluminum, silicon, phosphorous, sulphur, potassium, and calcium have been determined. In the analysis an abundance was derived from each line and wherever possible the line profile

rather than the equivalent width was used. Careful attention was paid to the details of Stark broadening and van der Waals broadening for the lines employed. For sodium an abundance analysis was performed using previously computed non-L.T.E. departure coefficients. It was found that these calculations gave abundances that were less consistent than those obtained by a L.T.E. analysis. It was also found that for certain lines of calcium non-L.T.E. effects appear to be present. For the other elements departures from L.T.E., if present, are within the uncertainty of the f-values. These differences are due principally to the model atmosphere used in this analysis and in the case of magnesium to the influence of Stark broadening. Dissert. Abstr.

N68-31064# Royal Aircraft Establishment, Farnborough (England).
SYNTHESIS OF THE ANALYTICAL RESULTS ON OPTIMAL TRANSFERS BETWEEN KEPLERIAN ORBITS [SYNTHESE DES RESULTATS ANALYTIQUES SUR LES TRANSFERTS OPTIMAUX ENTRE ORBITES KEPLERIENNES]
Christian Marchal, Jean-Pierre Marec, and C. B. Winn (Colorado State Univ.) Mar. 1968 57 p refs Transl. into ENGLISH of the ONERA Rept., No. 515, 1967
(RAE-LIB-TRANS-1281) CFSTI: $3.00

The optimization of the final mass depends upon the propulsion systems which are classified as high thrust systems and low thrust systems. The analytical resolutions utilize the classical optimization theories of the calculus of variations as well as more recent ones. They are classified into time-free and time-fixed cases as well as studies of singular arcs. Author

N68-31098# Paris Univ., Orsay (France). Lab. de Physique Theorique et Hautes Energies.
SELF-CONSISTENT HOMOGENEOUS ISOTROPIC COSMOLOGICAL MODELS. 1: GENERALITIES
Remi Hakim Mar. 1968 26 p refs
(LPTHE-TH-68/7)

Self-consistent models of uniform universes are provided by coupling Einstein's equations to the one-particle Liouville equation: correlations between the "particles" of the cosmic gas are thus neglected. As a consequence an equation of state is not needed in the theory but rather provided from these statistical considerations. It is shown that an expanding self-consistent uniform Universe behaves asymptotically as the relativistic polytrope $p \approx \mu^{5/3}$ and finally as an expanding Friedmann Universe. Near the possible singularity R = 0 (R = scale factor) self-consistent models are hot models. Friedmann models are shown to be a particular case of self-consistent models. Author (NSA)

N68-31168*# Bellcomm, Inc., Washington, D. C.
RANDOM INDEPENDENT SPLITTING MODEL FOR THE MASS SPECTRUM OF PROTOSTARS AND INTERSTELLAR CLOUDS
A. H. Marcus 7 Jun. 1968 35 p refs
(Contract NASw-417)
(NASA-CR-95938; TR-68-340-2) CFSTI:HC $3.00/MF $0.65 CSCL 03B

It is often assumed that stars are formed when a large initial cloud splits up into smaller fragments, each of which may in turn split into smaller pieces, and so on. This continues until the final stage before the cloud condenses into a visible star, at which stage the cloud fragment may be called a protostar. We present a simple mathematical model for the expected number density (i.e., "mass spectrum") of cloud fragments which does not require detailed knowledge of the physics of the fragmentation process, but uses merely some simple and plausible phenomenological hypotheses. The present state of empirical evidence about the initial mass spectrum of protostars and interstellar clouds is first reviewed. We then describe and expand upon a mathematical model proposed by Filippov (1960) for the mass spectrum of objects formed by the repeated random independent splitting of an initial object. Author

N68-31177 Rutgers Univ., New Brunswick, N. J.
THE TURBULENT NEAR-WAKE OF AN AXISYMMETRIC BODY AT SUPERSONIC SPEEDS
Christian E. G. Przirembel (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14748

The Rutgers Axisymmetric Near-Wake Tunnel provided a natural axisymmetric base flow field, which is free of model support disturbances and main stream disturbances. The near-wake flow field may be studied by introducing instrumentation from the base through the subsonic recirculation region. Special provisions were made to insure a clear optical path for Schlieren studies of the near-wake. The experimental results in this investigation were obtained with a uniform main flow at a Mach number of 3.91, and a base diameter of 3.00 inches. The stagnation pressure of the air was 182.5 psia, and the free-stream Reynolds number was 18.2×10^6 per foot. A standard, subsonic, pitot-static probe was used to measure static and stagnation pressures along the centerline of the near-wake. Mach number and velocity distributions along the model axis were calculated from these measurements. The rear stagnation point was determined by observing the point at which the static and pitot pressures were equal. The location of this point was optically verified by a water injection technique. Methods of estimating the base pressure and the length of the constant pressure region for an axisymmetric, blunt-based model were obtained. Dissert. Abstr.

N68-31182*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SECOND ORDER THEORY OF MOTION IN THE VICINITY OF THE EARTH-MOON LIBRATION POINT L_2 WITH THE EFFECT OF SOLAR PERTURBATION
Uriel Domb (Bendix Field Eng. Corp.) Jun. 1968 69 p refs Prepared by Bendix Field Eng. Corp.
Contract NAS5-9870
(NASA-TM-X-63293; X-551-68-226) CFSTI: HC $3.00/MF $0.65 CSCL 03C

The development of a second order theory for trajectories in the vicinity of the lunar libration point L_2 is presented. This development is based on a four-body model including the sun, earth, moon, and a satellite, all assumed to move in the same plane. As a result we obtain a system of two simultaneous second order differential equations with time dependent coefficients. Some selected solutions of interest are derived, including a first order periodic solution and a second order quasi-periodic solution. Various trajectories around L_2 are plotted and computations of the velocity, acceleration, range, range rate and flight path angle are presented. Author

N68-31183*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
TEMPERATURE STRUCTURE OF NONGREY PLANETARY ATMOSPHERES
James B. Pollack May 1968 29 p refs
NGR-09-015-023 (Grant NGR-09-015-023)
(NASA-CR-95947; SAO-802-180) CFSTI: HC $3.00/MF $0.65 CSCL 03B

To reduce by several orders of magnitude the number of frequency points needed in calculating net fluxes for molecular atmospheres, transmission average opacities are introduced. A power-law representation of these broad-band opacities is suggested for paths at constant pressure and temperature and generalized to nonhomogeneous paths. These broadband opacities fail to obey the rules of superposition and as a result there is a greater tendency

toward convective instability. Approximate formulas are developed for the temperature gradient near presented to obtain the distribution of solar energy deposition within a planetary atmosphere, which exhibits scattering and absorption by gas molecules, cloud aerosols, and the ground. This information is needed to find the amount of net thermal flux at any level of the atmosphere. Author

N68-31203 Czechoslovak Academy of Sciences, Prague.
EPHEMERIS FOR 1968 [HVEZDARSKA ROCENKA 1968]
Jiri Bouska, Vladimir Guth, Bedrich Onderlicka, and Jaroslav Ruprecht 1967 193 p refs In Czech /t Publ. No. 44

The ephemerides are given for the sun, the moon, the planets and their moons, eclipses and occultations, planetoids, comets, meteors, stars, and variable stars. A calendar of constellations and the ephermeris time signals are listed and discussed. Briefly discussed are also celestial mechanics, fundamental astronomy, the sun and all planets, comets, meteors, stars, binary stars, clusters, interstellar masses, galaxies, cosmic radiation, extragalactic systems, stellar evolution, quasars, and cosmology. Transl. by K.W.

N68-31234 Hawaii Univ., Honolulu.
DEVELOPMENT OF A NEW THEORY FOR DETERMINATION OF GEOPOTENTIAL FROM THE ORBITAL MOTION OF ARTIFICIAL SATELLITES
Mohammad Asadullah Khan (Ph.D. Thesis) 1967 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-13702

A new theory has been developed to exploit the satellite data particularly the position vector and the relative velocity of a satellite in the problem of obtaining the terrestrial gravity field with special consideration to its localized anomalous features. The theory makes use of the fact that the dynamical variable Hamiltonian, associated with the satellite motion is time-invariant in the ideal case when all the perturbing forces are neglected. With this as a working premise, it is possible to take into account the effects of the perturbing forces such as lunar attraction, air drag, radiation pressure and solar attraction. The ideal case ignoring all the perturbing forces, here called the simplified theory and the more factual case allowing for the effect of the important perturbing forces, here called the extended theory are both discussed in detail. Dissert. Abstr.

N68-31283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SURVEY OF COMET MISSIONS
James B. Eades, Jr. Jul. 1968 13 p refs Presented to the Spec. Proj. Branch 6 Astrodyn. Astrodyn. Conf., Greenbelt, Md., 7–8 Nov. 1967
(NASA-TM-X-63295; X-643-68-263) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A discussion of comets and the possibility of scientific missions to these bodies, as they pass through the solar system, is presented. Mention is made of the probable experimental devices needed to accomplish these missions. The candidate comets (through 1986) are noted and discussed in regards to the requirements needed for each flight operation. Author

N68-31313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT CERTAIN APPROXIMATED SOLUTIONS OF GAS DYNAMIC EQUATIONS [O NEKOTORYKH PRIBLIZHENNYKH RESHENIYAKH URAVNENIY GAZODINAMIKI]
I. A. Klimishin 26 Sep. 1967 10 p refs Transl. into ENGLISH from Vopr. Kosmogonii, Akad. Nauk SSSR (Moscow), v. 10, 1964 p 146–152
(FTD-HT-23-514-67; AD-670910)

Part 1 is a discussion of methods for the study of the dissipation of a shock wave in a stellar atmosphere. Part 2 analyzes the possibility of the extended atmosphere of a star being maintained by periodic shock waves. Part 3 reviews studies of the structure of a shock wave accompanied by radiation. The studies of 29 authors are cited to indicate that the possibilities of solving the three mentioned problems have by no means been exhausted. Author (TAB)

N68-31324*# Bendix Corp., South Bend, Ind. Analytical Mechanics Engineering Dept.
LUNAR MODULE (LM) SOIL MECHANICS STUDY, VOLUME 1 Final Report, May 1966 – Feb. 1968
H. K. Winters et al 1 May 1968 456 p refs
(NASA-CR-92208; AM-68-1, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Soil selection and control are considered in terms of developing soil force laws to give the interrelationships between the Lunar Module (LM) footpad motions and forces acting on the footpad during touchdown. Control motion test equipment for soil/footpad dynamical interactions is described, as is the development of an analytical force/motion model that accounts for the interaction of the lunar soil and the footpads. The semi-empirical approach taken in developing the force relationships for the LM footpads consisted of soil categorizing, developing a preliminary mathematical model, selecting soils characteristic of lunar surfaces, testing and data analysis, model improvement, and verification of the derived force law. Soil analyses indicated that the soil reaction on the footpad could be represented by a nonlinear, second order system. Footpad reaction was divided into axial and normal forces. The mass of the soil was considered the result of a stagnation mass, and variations in soil resistance with penetration direction were accounted for by the mechanical strength and momentum transfer portions of the mass. M.W.R.

N68-31377*# Bellcomm, Inc., Washington, D. C.
COVARIANCE FUNCTION OF ELEVATIONS ON A CRATERED PLANETARY SURFACE. PART 1: CRATER BOWL CONTRIBUTION
Allan H. Marcus 21 Jun. 1968 35 p refs
(Contract NASw-417)
(NASA-CR-95983; TR-68-340-3) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The covariance function of elevations on a plane planetary surface, which has been excavated by primary meteoritic impact craters, is derived according to various models of crater size and shape, and an assumed inverse power law meteor mass distribution. At distances less than the diameter of the smallest crater, the shape of the covariance function reflects crater geometry rather than meteor mass distribution, being linear for cylindrical craters and parabolic for paraboloidal craters. At small and moderate distances the covariance function has roughly the form suggested by Chernov. The derived functions can be used in studies requiring statistical characterization of lunar surface roughness, such as mobility of lunar roving vehicles or interpretation of radar power returns. Author

N68-31418*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE CONTROL AND USE OF LIBRATION-POINT SATELLITES
Robert W. Farquhar Jul. 1968 214 p refs
(Grant NsG-133-61)
(NASA-CR-95948; SUDAAR-350) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Consideration is given to satellite station-keeping in the vicinity of the unstable collinear libration points, L_1 and L_2. Station keeping problems at other libration points, including an isosceles

triangle point, are also treated, but to a lesser degree. A detailed analysis of the translation-control problem for a satellite in the vicinity of a collinear point is presented. Simple linear feedback control laws are formulated, and stability conditions are determined for both constant and periodic coefficient systems. Other translation-control analyses of this study include (1) solar-sail control at the Earth-Moon collinear points, (2) a limit-cycle analysis for an on—off control system, and (3) a method for stabilizing the position of the mass center of a cable-connected satellite at a collinear point by simply changing the length of the cable with an internal device. For certain applications, a satellite is required to follow a small quasi-periodic orbit around a collinear libration point. Analytical estimates for the corrections to this orbit due to the effects of nonlinearity, eccentricity, and perturbations are derived. Several possible libration-point missions are proposed. Author

N68-31431# Max-Planck-Institut fur Kernphysik, Heidelberg (West Germany).
RARE GASES IN STONY METEORITES
J. Zaehringer 1967 54 p refs
(MPIH-1967/5/11) CFSTI: HC $3.00/MF $0.65

Contents and isotopic composition of He, Ne, and Ar were analyzed in 81 stony meteorites. The He 3 exposure ages and the radiogenic He 4 and K—Ar ages confirm the conclusions of previous publications. The exposure ages of diogenites are clustered around 20 million years. Also determined were the contents of Kr 84 and Xe 132 and the Xe 129/Xe 132 ratio in 92 stony meteorites. The Kr 84 and Xe 132 contents as well as the content of the Xe 129 excess are proportional to the primordial Ar 36 content over a larger range. Some conclusions are presented regarding the model on I-Xe 129 dating. K.W.

N68-31434*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
MODEL ATMOSPHERES FOR RR LYRAE STARS
S. E. Strom Jul. 1968 12 p refs
(Grant NGR-22-024-001)
(NASA-CR-95982; SAO-806-102) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Model atmospheres have been computed in the range $6000 < T_{eff} < 7500°K$ with $2.0 < \log g < 3.5$. These parameters are representative of those that obtain for stars in the RR Lyrae gap. Convection is found to play a significant role in the influence of the emergent fluxes predicted by these models. Temperature determinations based on purely radiative models are systematically too low by as much as 200°–350°K; gravity determinations are not affected. The method of predicting (B-V), and thus reddening, from the strength of the Balmer lines is found to give less than desirable results. The influence of line blanketing and departures from LTE on these models is also discussed. Author

N68-31452# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
ORBIT PERTURBATIONS OF ARTIFICIAL EARTH SATELLITES AS FUNCTIONS OF GRAVITY ANOMALIES AND DIFFERENTIAL
Karl-Rudolf Koch Jan. 1968 43 p refs
(Contract AF 19(628)-5701)
(Rept.-96; SR-17; AD-670605)

In the first part of this report the orbit perturbations of an artificial earth satellite are given as functions of the gravity anomalies by means of Stokes formula. To compute the perturbations, the perturbed equations of motion are integrated numerically and the usual integration technique is applied for Stokes formula by dividing the surface of the earth into surface elements in which the gravity anomaly and Stokes function are regarded as constants. In a numerical example orbit perturbations are computed for three satellites with different orbital elements from mean anomalies of different sizes of surface elements to determine the influence of the sizes of surface elements on the orbit perturbations. In the second part it is assumed that the gravity field of the earth is well known from gravity anomalies. To obtain a precise orbit of a satellite by these data, a method using differential corrections is given to compute more accurate orbital elements and more accurate coordinates of the tracking stations, whose observations determine the orbit. Author (TAB)

N68-31520*# Volt Technical Corp., Washington, D. C.
NEAR PLANETARY SPACE
12 Aug. 1968 3 p Transl. into ENGLISH from French
(Contract NAS5-12487)
(NASA-CR-96118; ST-LPS-PMF-10730, Add. 1) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Venera space probe measurements on magnetic fields and radiation belts in the Venus vicinity were evaluated. Results showed that the intensity of possible trapped radiation near Venus may be at least one million times weaker than that near Earth and that noticable magnetic fields were absent. Photometric ultraviolet observations established the presence of a hydorgen corona in Venus. The atomic oxygen density 300 to 350 km above the night or morning side of the planet did not exceed 2×10^3 atoms/cm^3. G.G.

N68-31594*# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
RADAR STUDIES OF THE LUNAR SURFACE EMPHASIZING FACTORS RELATED TO SELECTION OF LANDING SITES Final Report, 1 Jul. 1966 – 31 Dec. 1967
Thomas W. Thompson Apr. 1968 117 p refs
(Grant NGR-33-010-024)
(NASA-CR-96137; RR-RS-73) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The radar reflectivity of one-third of the visible lunar surface was mapped at a wavelength of 70 cm using the delay-Doppler technique. The resolution of the radar echo in either time delay or frequency was equivalent to localizing the deflecting areas to strips with widths of 5–10 km. The depolarization of the echo was studied by transmitting a circularly polarized wave and simultaneously receiving opposite circular polarizations. It was possible to infer differences in roughness of the lunar surface on a meter scale from the depolarization of the radar echo. Both rayed and young craters were found to be rough. Several craters had only rough rims, which may be the result of an aging process that selectively smooths the floor of a crater. The mountains were found to be rougher than the adjacent maria. Differences in roughness within a mare were observed, and in one case, the difference could not be correlated with optical features. The scattering behavior of the moon, power as a function of delay, was measured at a wavelength of 7.5 m. This agreed with previous measurements at a wavelength of 6 m. Author

N68-31600*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RETURN TO VENUS
1 Jul. 1968 36 p refs
(Contract NAS7-100)
(NASA-CR-96141; JPL-TM-33-393) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Preparation, launch, voyage, and encounter with Venus are described for the Mariner V. Previous Mariner probes of Venus and Mars are noted, and a general review of the composition and properties of Venus is presented. Heat design modifications required by Mariner V are described, as are the other changes in both the spacecraft and its instrumentation. The Atlas/Agena launch vehicle, overall launch preparations, and attitude control of the spacecraft are mentioned; and weather conditions in space and communication

with Mariner V are discussed. The Mariner Venus encounter events are tabulated, along with the highlights of the Mariner V flight log. M.W.R.

N68-31631# Astra Advisory Committee, Washington, D. C.
REPORT OF THE ASTRA ADVISORY COMMITTEE
Jul. 1968 73 p refs

Presented are scientific and operational specifications for the development of a man attended telescope to be used for the next generation of orbital observatories. The telescope consists of primary and secondary optics, can be attached to the spacecraft, and posesses attachment for changeable experiments packages. In addition to high resolution imagery and spectroscopy the observatory will be used to analyze nuclei of galaxies at wavelengths shorter than 3000 Å, to observe the gaseous nebulasities in our galaxy, and to investigate stellar abundances and interstellar material by high resolution ultraviolet spectroscopy. A list of specifications for the orbital observatory and its optics is included together with the proposed experiments. G.G.

N68-31695*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.
OSCILLATOR STRENGTHS OF THE RED AUTOIONIZING LINES OF CALCIUM
G. H. Newsom [1968] 12 p refs
(Grant NGL-22-007-006; Contract Nonr-1866(48))
(NASA-CR-96146; SR-26) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A shock tube experiment was designed to measure relative gf-values of the calcium autoionizing lines near γ6360. Results from other experimenters for normal transitions have been used to place the gf-values on an absolute scale, with an estimated error of 20 per cent. The laboratory line strengths are compared with the observed line depths in the solar spectrum. Author

N68-31713
ON SOME CONTROL LAWS FOR A SPACE VEHICLE ORBIT
D. A. Mamatkazin [1968] 5 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 3, 1968 p 513–516
CFSTI: HC $3.00/MF $0.65

Control laws are proposed to permit an analytical solution to the problem of space vehicle motion under the effect of a controlling acceleration in a plane perpendicular to the absolute velocity vector of its center of gravity. A figure depicts the orientation of the O–x–y–z axes relative to the inertial coordinates; the orientation is determined by the longitude of the ascending node, the declination of the instantaneous orbit plane to the equator, and the slant range. Equations of vehicle motion are derived, and differential equations are formulated to define the rates of change of the angles of the rotating axes relative to the inertial coordinates. The laws presented are for changes in trajectory motion and permit an exact solution to be obtained for vehicle motion in circular, elliptical, parabolic, and hyperbolic orbits. Author

N68-31778# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
CONSTRUCTION OF ORBITS ASYMPTOTIC TO A PERIODIC ORBIT
Andre Deprit and Jacques Henrard Apr. 1968 27 p refs *Its* Mathematical Note No. 554
(D1-82-0715; AD-670794)

In the immediate neighborhood of an unstable periodic orbit, the families of orbits asymptotic to it may be expanded in power series of an orbital parameter, the coefficients being successive variations of increasing order from the generating orbit. When the dynamical system is Hamiltonian, conservative and with two degrees of freedom, the intrinsic components of these variations are shown to be solutions of a recurrent sequence consisting at each step of a nonhomogeneous Hills equation for the normal displacements and of a quadrature for the tangential components. Accordingly, Floquets theory reduces the construction of the asymptotic series to a chain of routine operations, like trigonometric interpolations and elementary primitives. In the case of the restricted problem of three bodies, even the development of the force function about the periodic orbit can be implemented automatically on a computer. Author (TAB)

N68-31800*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE FLIGHT EXPERIMENTS PROGRAM
[1968] 33 p
(NASA-TM-X-61148) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Short resumes of some 60 NASA mission-related experiments are presented which were developed in the MSFC laboratories, in universities, and in industry. These experiments, managed by the Flight Experiments Office, represent such disciplines as fluid behavior, materials, atmospherics, spacecraft environment, space environment, thermodynamics, lunar and planetary environment, optical technology, assembly and maintenance, and inspection and checkout. D.H.B.

N68-31831*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 1: SUMMARY Final Report, 26 Mar. – 1 Jul. 1968
Raymond S. Wiltshire and Hugh E. Craig Washington NASA Aug. 1968 95 p
(Contract NAS1-7976)
(NASA-CR-66659) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Mission and subsystem parametric analyses were conducted to evaluate the direct and out-of-orbit entry modes for soft landing capsules, and to obtain the net science payload for the direct entry mode. Mission analysis data are presented on launch period, targeting, and error analysis; entry environment; and terminal phase system comparisons and launch vehicle capability. These findings indicate that the out-of-orbit mode permits a greater mission flexibility than the direct entry mode, and that both modes require the Titan 3C/Centaur to deliver useful payloads of 600 lb. Comparisons of specific capsule configurations show that the 8 1/2-ft diameter aeroshell is marginal from a packaging viewpoint; the 10 1/2-ft diameter is preferred. Point designs are described for the science subsystem, structures and mechanisms, and propulsion, guidance and control, telecommunications, power, and thermal control subsystems. The preferred design for each is identified, and the long-lead items are listed for these designs. Mission mode selection was found to have little effect on the capsule subsystems, although the direct mode entry environments are slightly more severe. Areas meriting further investigation are identified. M.G.J.

N68-31832*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 2: PARAMETRIC STUDIES, FINAL ANALYSES, CONCEPTUAL DESIGNS
Raymond S. Wiltshire Washington NASA Aug. 1968 297 p refs
(Contract NAS1-7976)
(NASA-CR-66660) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Parametric analyses were conducted to evaluate various aspects of the Mars missions in the 1973 to 1977 period both from the viewpoint of mission mode, and types of delivery systems. Launch vehicle performance, launch period selection, targeting capability, entry corridors, terminal phase, and aerothermodynamics were considered. Performance data are presented on the Titan 3C,

Titan 3F/stretch transtage, Titan 3C/Centaur, and Titan 3F/Centaur. The entry corridor and landing site footprint were also analyzed, along with the effect of mission mode choice on targeting, deorbit/deflection velocity increment, entry flight path angle, required aeroshell ballistic coefficient, parachute size, parachute deployment altitude, time on parachute, required vernier ignition altitude, and landing terrain height. Conceptual capsule designs are assessed, covering a range of capsule weights and including integration with a launch vehicle. It was found that the out-of-orbit mode permits more in-flight mission flexibility than the direct mode by providing site survey and an opportunity to correct malfunctions prior to separation, targeting change capability, and higher landed weights within a given aeroshell diameter. M.G.J.

N68-31833*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 3: APPENDIX A—LAUNCH VEHICLE PERFORMANCE AND FLIGHT MECHANICS
Hugh N. Zeiner and Donald W. Marquet Washington NASA Aug. 1968 259 p
(Contract NAS1-7976)
(NASA-CR-66661) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Performance capabilities are analyzed for the Titan 3C, Titan 3F/stretched transtage, Titan 3C/Centaur, and Titan 3F/Centaur launch vehicles. Mars mission opportunities of 1973, 1975, and 1977 with both Type 1 and Type 2 transfer trajectories are considered. Ejection/deorbit maneuver strategy and target data are presented to provide possible locations of the landing site with respect to orbit periapsis for both the direct and orbit modes. The maneuver strategies consider tradeoffs between propulsive requirements, telecommunications requirements, and the entry dispersions due to navigation uncertainty and maneuver execution errors. The targeting analysis considers the means for obtaining longitude and latitude control of the landing site as well as its location with respect to the evening terminator. An error analysis was also conducted, with (1) navigation uncertainty at ejection or deorbit, and (2) pointing and impulse ejection errors considered as the error sources for both the direct and orbit modes. M.G.J.

N68-31834*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 4: APPENDIX B—ENTRY AND TERMINAL PHASE PERFORMANCE ANALYSIS Final Report
Charles E. French and Duane A. Howard Washington NASA Aug. 1968 312 p
(Contract NAS1-7976)
(NASA-CR-66662) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Entry and terminal phase performance analyses were conducted to determine entry trajectory characteristics in order to define the entry environment and terminal phase initial conditions for the two mission modes; compare mission modes for several terminal phase deceleration systems; and assess terminal phase deceleration system performance for each mission mode. Parametric Mars entry trajectory data are presented in the form of carpet plots at a constant value of entry velocity with the dependent variable a function of entry flight path angle and entry ballistic coefficient. The terminal phase systems considered include subsonic-type parachute plus vernier, tuckback ballute plus vernier, all-retro propulsion landing system, and two-burn systems, making use of a solid rocket motor for braking before parachute or all-retro system deployment. Useful landed weight is defined as a function of aeroshell diameter, entry conditions and dispersion, and required launch vehicle. Sensitivity to design parameters such as landed terrain height and decelerator size is also factored into the analysis along with the constraints under which the system is assumed to perform. M.G.J.

N68-31835*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 5: APPENDIX C—ENTRY CONFIGURATION ANALYSIS Final Report
Herbert C. Norman and Harry E. Sparhawk Washington NASA Aug. 1968 103 p
(Contract NAS1-7976)
(NASA-CR-66663) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Parameters are defined for the aeroheating analyses of the stagnation point and the cone edge of the aeroshell; these points are considered adequate for defining the heating to the aeroshell and the ablator weight. Summay data are provided on the maximum heating rates, total heating loads, and aerodynamic shear stresses. Design criteria for the ablative heat shield system reflect the relative uncertainties associated with the various heating components. Safety factors were applied to the calculated heating rates for the various trajectories considered, and ablation analyses were used to determine the required heat shield thickness. For the aeroshell parametric study, consideration was given to an all-aluminum structure with deployable aluminum flaps or inflatable coated-Nomex fabric airmats as required to achieve the desired entry weights and ballistic coefficients. The configuration consists of a truncated cone with the half-included angle ranging from 45° to 70°. Various design pressures and loads to satisfy design conditions for both the direct and orbital entry mode are examined. Parametric weight curves are depicted. M.G.J.

N68-31836*# Martin Co., Denver, Colo.
STUDY OF DIRECT VERSUS ORBITAL ENTRY FOR MARS MISSIONS. VOLUME 6: APPENDIX D—SUBSYSTEM STUDIES AND PARAMETRIC DATA Final Report
Raymond S. Wiltshire, William D. Van Arnam, Thomas R. Tracey, Frederick A. Jaeger, Parker S. Stafford et al Washington NASA Aug. 1968 290 p refs
(Contract NAS1-7976)
(NASA-CR-66664) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Component and subsystem parametric weight equations are derived, and the empirical or theoretical curves used to develop these equations are presented. Detailed weight statements of the three point design configurations are included. Data and procedures are developed for estimating the thermal control system weight over a wide range of parameters, with emphasis placed on the Mars surface mode. Propulsion parametric data include subsystem weight as a function of velocity increments, and comparisons of monopropellant and solid deorbit systems, blowdown and regulated pressurization systems, and monopropellant and nitrogen attitude control systems. Several approaches to guidance and control are assessed. Analytical data are also provided on data handling and storage conceptual designs and procedures; telecommunications configurations; power and pyrotechnic subsystems performance; selection of wind and humidity instruments for a meteorology package; and a tentative concept for a Mars soil sampler. A mathematical model is presented on the entry science error analysis which was conducted to determine the necessary planetary lander instrumentation needed for estimating the atmosphere. M.G.J.

N68-31887*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTEGRATED EXPERIMENT FOR COMPOSITIONAL ANALYSIS FROM AN ORBITER
Isidore Adler and Jacob Trombka Aug. 1968 24 p refs
(NASA-TM-X-63303; X-641-68-314) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Some proportion of atomic and nuclear radiation naturally emitted from the moon is characteristic of the elements that make

up the lunar surface. Detection and analysis of this radiation can be used to determine chemical composition. Accordingly, an integrated experiment package for measuring gamma rays—natural and induced, secondary X rays, alpha particle emission, and neutron albedo is described. The advantages in this approach are an economy in technology and more comprehensive data collection, leading to improved interpretation of lunar processes. Author

N68-31893# Stuttgart Univ. (West Germany).
FUEL OPTIMAL GUIDANCE LAW FOR SPACE VEHICLES AND ITS APPLICATION TO SOFT LANDING ON THE MOON [MASSENVERBRAUCHSOPTIMALES STEUERGESETZ FUER RAUMFAHRZEUGE UND SEINE ANWENDUNG AUF DIE WEICHE LANDUNG AUF DEM MOND]
L. T. Kayser Jul. 1968 62 p refs In GERMAN; ENGLISH summary
(AGRR-TB-16) CFSTI: HC $3.00/MF $0.65

A fuel optimal guidance law for space vehicles is described, that defines amount and direction of the thrust vector as a function of the state variables. A sample integration of a soft moon landing using that guidance subroutine is included. A 1% increase in payload could be demonstrated against a gravity turn landing. Author

N68-31895* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A FORTRAN 4 PROGRAM FOR PREDICTING THE UNCONTROLLED DYNAMIC RESPONSE CHARACTERISTICS OF A SPINNING, CABLE-CONNECTED, TWO-BODY SPACE STATION
William E. Thomas, Jr. May 1968 114 p ref
(NASA-TM-X-58018) CFSTI: $3.00 CSCL 22A

A 12-degree-of-freedom FORTRAN 4 digital computer program is presented to determine the nonlinear motion of two rigid bodies connected by massless cables and subject to external disturbances. Author

N68-31982*# Scripta Technica, Inc., Washington, D. C.
A PRELIMINARY STUDY OF ORBITAL CORRECTIONS BY MEANS OF A SMALL THRUST [PRELIMINARES AU PROBLEME DES CORRECTIONS ORBITALES A FAIBLE POUSSEE]
E. Cambi NASA Aug. 1968 29 p refs Transl. into ENGLISH of the French Rept., Paris, Aug. 1967 p 1–35
(Contract NASw-1694)
(NASA-TT-F-11827; ELDO-TM-101) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A synthesis is presented of methods of orbital transfer by means of a small thrust, especially the direct equations expressing the coordinates of the mobile point as a function of time, and the planetary equations which express the law of variation of the parameters of an osculating orbit. It can be seen that the latter equations are much more amenable to treatment, especially if one takes the time average of the terms in order to determine the secular variations. However, by means of examples it is shown that the latter procedure is dangerous, and that it is in any case preferable to utilize the direct equations. Author

N68-31989*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A TRAJECTORY CODE FOR MAXIMIZING THE PAYLOAD OF MULTISTAGE LAUNCH VEHICLES
Omer F. Spurlock and Fred Teren Washington Aug. 1968 168 p refs
(NASA-TN-D-4729) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A computer code is described that quickly maximizes the payload of a multistage launch vehicle. Calculus of variations techniques are used to optimize the trajectory and propellant loadings (optional) of one to six stages. The flow rate and vacuum thrust of each stage are constant. The jettison weight is a linear function of the propellant loading. The computer time is greatly reduced by minimizing the integration of atmospheric (booster) portions of the trajectory. A table of booster burnout conditions is formed from a limited number of boost trajectories. The table is used in conjunction with an interpolation scheme to obtain initial conditions for the vacuum portion of the trajectory. Author

N68-32000# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES, NUMBER 2, 1963
May 1968 273 p refs Transl. into ENGLISH from RUSSIAN *Its* Astron. Papers No. 12

Observational and orbit calculation methods for artificial earth satellites are presented in this collection of astronomical papers. Emphasis is placed on the use of synchronous observations of celestial objects for purposes of higher geodesy. G.G.

N68-32002# Polish Academy of Sciences, Warsaw.
A METHOD OF ASTROMETRIC REDUCTION OF SYNCHRONOUS OBSERVATIONS OF ARTIFICIAL SATELLITES
B. A. Firago *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 15–29 refs (See N68-32000 19-30)

A method of reduction of the first round of synchronous observations of Satellite Echo 1 is examined. Printing chronographs with quartz crystal oscillators, quartz clocks, and receivers tuned to observatory time-signal transmitters are used to determine the universal standard time (UT2) for calibration of the synchronous moment, excluding the aberrational time. The astrographic coordinates of a synchronous position of the satellite are determined by the familiar methods of photographic astrometry. The derived mean coordinates of the satellite at the normal epoch of the star position catalog are reduced to the satellite-tracking epoch, after which corrections are applied for the annual aberration of reference stars, refractive parallax of the satellite, and diurnal motion of the earth. The most laborious calculations were carried out with a Ural-1 computer. The result was the topocentric apparent equatorial coordinates (α, δ) of the equinox of the satellite-tracking epoch. These spherical coordinates of the satellite in relation to directions referred to the mean axis of the earth's rotation are suitable for immediate geodetic use at this stage of reduction of the synchronous observations. Author

N68-32003# Polish Academy of Sciences, Warsaw.
ADJUSTMENT OF A SPACE TRIANGULATION
G. A. Ustinov *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 31–41 refs (See N68-32000 19-30)

Techniques and working formulas are tested for strictly interlinked adjustment of all measurements of a space triangulation to determine the coordinates of the tracking stations on the basis of two or more well-known stations. The method advanced permits computation of station coordinates and adjustment of a space triangulation on the basis of "closing" directions. Author

N68-32004# Polish Academy of Sciences, Warsaw.
MODEL OF SPACE TRIANGULATION BASED ON NONSIMULTANEOUS OBSERVATIONS OF SATELLITES
A. Dinescu *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 43–74 refs (See N68-32000 19-30)

It is shown how to determine the coordinates of stations by space triangulation using the simultaneity circle. The model is calculated for fictitious satellites and nonsimultaneous

"observations," and the orbit need not be known. Two versions of the problem are solved: with three simultaneous observations of three different satellites, and with two times of observation and the equation of the plane tangent to the ellipsoid at the point of the station. A comparison of rectangular geocentric coordinates of satellites as obtained by this method and the theoretical coordinates justifies the use of the simultaneity circle. When three times of observation are used, the distance between the accepted and the newly determined positions of the station is 7.9 m. With the second version, this distance is 3.6 and 3.9 m in two examples. The effect of errors on the geocentric coordinates of the satellite is also established. Author

N68-32007# Polish Academy of Sciences, Warsaw.
THE ACCURACY OF SYNCHRONOUS VISUAL OBSERVATIONS UNDER THE INTEROBS PROGRAM IN 1962
I. Almar *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 87–93 refs (See N68-32000 19-30)

All synchronous visual observations of Satellite Echo 1 at Baja, Hungary, and Bautzen and Rodewisch, GDR, during 1962 are used to determine a total of 14 sets of subsatellite points. Curves fitted to the 58 subsatellite points are compared with corresponding predictions of the Smithsonian Institution. The accuracy and usefulness of the proposed method (INTEROBS) of determination of satellite orbits are examined on the basis of the mean and standard deviations in the direction at right angles to the track. The radial distances of the satellite are then calculated for 10 selected points. The standard deviation in the plane normal to the orbital motion amounts to 6.36 km. Author

N68-32008# Polish Academy of Sciences, Warsaw.
ASSESSMENT OF DR. ILL'S METHOD FOR CALCULATING THE GEOCENTRIC RADIUS VECTORS OF ARTIFICIAL EARTH SATELLITES
T. V. Kasimenko *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 95–99 refs (See N68-32000 19-30)

The results of an assessment of the method of Dr. M. Ill, Hungary, for calculating the geocentric radius vectors of artificial earth satellites are reported from the Astronomical Council, Academy of Sciences of the USSR. Synchronous photographic observations of Satellite Echo 1 at the tracking stations in Nikolayev, Pulkovo, and Kharkov were used to calculate the geocentric radius vectors of the satellite by Dr. Ill's method and by the geometric method employed in the reduction of synchronous photographic observations. The accuracy of the method was estimated from the corresponding difference. It is found that Dr. Ill's method permits determination of the radius vector to within 1 km. Author

N68-32010# Polish Academy of Sciences, Warsaw.
CALCULATION OF ORBITS AND EPHEMERIDES OF MAN-MADE SATELLITES
G. A. Chebotarev, A. S. Sochilina, and E. N. Makarova *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 109–140 refs (See N68-32000 19-30)

The problem of determination of the orbits and calculation of ephemerides of close earth satellites is considered in connection with two methods (Laplace and Gauss-Bazhenov) for determining preliminary orbits. Integral expressions obtained by Kozai for the first-order perturbations are cited. The case of orbits with low eccentricities is also considered in detail. The effect of atmospheric drag is allowed for empirically. The complete set of formulas for practical calculations is given. Author

N68-32011# Polish Academy of Sciences, Warsaw.
APPROXIMATE EVALUATION OF ORBITAL ELEMENTS OF ARTIFICIAL SATELLITES FROM TOPCENTRIC DISTANCE MEASUREMENTS
W. Opalski *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 141–156 refs (See N68-32000 19-30)

An elementary formula for the triangle earth's center-observer-satellite leads to the relation among elements and measured distances. The basic procedure is to use the equation as a check and a guide for a rough estimate of the elements and, in the next step, for finding more accurate values. This is effected by analysis of diagrams that represent the right-hand side of the equation as a function of phase. First, a value of a is selected from a set of approximate values for the best fit to the observations. Similarly, values of two other elements are selected, and the remaining elements are evaluated from a diagram. The next step consists in computing corrections for three elements. Then a new diagram provides values of the remaining elements. An analytic method for improving the approximate elements is also presented, together with an examination of the coefficients of the relevant equations. Finally, a numerical example illustrates the procedure as applied to a set of fictitious observations. Author

N68-32012# Polish Academy of Sciences, Warsaw.
COMPUATION OF EPHEMERIDES OF ARTIFICIAL EARTH SATELLITES WITH THE URAL-2 DIGITAL COMPUTER
W. Pachelski *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 157–188 (See N68-32000 19-30)

The present method of computation of aphemerides is based on what are called the modified orbital elements, belonging to the category "input data." The modified orbital elements describe the satellite's motion in a system of coordinates rotating with the earth around its axis. The advantage gained by using the modified orbital elements in computing the ephemerides is obvious if we note the fact that the coordinates of any point on the earth (hence of any tracking station) are constant in this system, whereas in a stationary system they would be time-dependent. Author

N68-32013# Polish Academy of Sciences, Warsaw.
CRITERION FOR IDENTIFICATION OF MAN-MADE SATELLITES OF THE EARTH
A. Pal *In* Smithsonian Astrophys. Obs. Observations of Artificial Earth Satellites, No. 2, 1963 May 1968 p 189–262 refs (See N68-32000 19-30)

Dubiago's formulations of criteria are modified to allow for the specific characteristics of the motion of close satellites of the earth. The formulas are valid for two types of presentation of the observations, viz., for presentation in spherical equatorial coordinates and for presentation in spherical horizon coordinates. The computation of specific cases indicates that the criterion must be fulfilled strictly when simplifications are made. Author

N68-32024*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
THEORY OF A POTENTIAL FOR SATELLITE MOTION ABOUT A TRIAXIALLY ELLIPSOIDAL PLANET
Stephen J. Maddox, Jr. May 1968 29 p refs Presented at the 49th Ann. Meeting of the Am. Geophys. Union, Washington, D. C., 10 Apr. 1968
(Grant NGR-22-009-262)
(NASA-CR-98145; RE-34) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This report presents a generalization of an analysis due to Vinti which provides an accurate reference orbit for perturbation theories for earth satellites. The general potential function which permits separation of the Hamilton-Jacobi equation in triaxially

ellipsoidal coordinates is derived and specialized so that it satisfies the Laplace equation and qualifies as a gravitational potential. The theory of Stäckel systems is then applied to reduce the problem to quadratures. Author

N68-32057*# Harvard Coll. Observatory, Cambridge, Mass. Shock Tube Spectroscopy Lab.
THEORETICAL INTENSITIES OF RECOMBINATION LINES
Leo Goldberg Feb. 1968 42 p refs
(Grants NGL-22-007-006; NSF GP-6750)
(NASA-CR-96160; SR-25) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The effects of departures from thermal equilibrium on the intensities of radio recombination lines under conditions found in H 2 regions are presented. The equilibrium intensities are modified in two respects. First, the transition rate is proportional to the departure coefficient b_n of the initial level. Second, the magnitude of the stimulated emission is proportional to d ln b_n/dn and may be larger or smaller than the equilibrium value $(1-e^{-h\nu/kT_e})$ depending on whetehr the sign of the derivative is positive or negative, respectively. In hydrogen, the b_n values lie in the range 0.75–1.0 for all n greater than 50 and hence only the second effect is of major importance. In multi-electron atoms, however, the b_n values may exceed unity by one or more orders of magnitude and d ln b_n/dn may be positive, negative, or zero, depending on values of the principal quantum number and the electron density. Some applications of the theory are presented, based on recent calculations of the b_n factors for hydrogen and carbon. Author

N68-32058# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ASTRONOMICAL PAPERS TRANSLATED FROM THE RUSSIAN, PART 1
28 Nov. 1962 58 p refs
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. RADIO EMISSION FROM VENUS IN THE 4-MILLIMETER WAVELENGTH RANGE A. G. Kislyakov, D. A. Kuzmin, and A. E. Salomonovich p 1–2 refs (See N68-32059 19-29)

2. INFLUENCE OF THE CHANGING MASS OF THE SUN ON ELECTROMAGNETIC AND CORPUSCULAR RADIATION PRESSURE V. V. Radzievskii p 3–6 refs (See N68-32060 19-29)

3. POLARIZATION IN VARIOUS PARTS OF COMET AREND–ROLAND 1956h D. L. Astavin-Razumin p 7–12 refs (See N68-32061 19-30)

4. SOME NEW DATA ON THE STRUCTURE OF CHONDRITES L. G. Kvasha p 13–28 refs (See N68-32062 19-30)

5. DETERMINATION OF RELATIVE gf-VALUES OF CHROMIUM (Cr 1) L. A. Mitrofanova p 29–33 refs (See N68-32063 19-30)

6. STELLAR MODELS FOR THE MAIN SEQUENCE WITH THE ABSORPTION LAW $k = k_0 \rho^{0.875} T^{-3.5}$ A. G. Massevich, V. P. Mateeva, and L. N. Tulenkova p 35–52 refs (See N68-32064 19-30)

N68-32061# Smithsonian Astrophysical Observatory, Cambridge, Mass.
POLARIZATION IN VARIOUS PARTS OF COMET AREND-ROLAND 1956H
D. L. Astavin-Razumin *In its* Astron. Papers Transl. from the Russian, Pt. 1 28 Nov. 1962 p 7–12 refs Transl. into ENGLISH from Byull. Vsesoyuz. Astronomo-Geod. Obshchestva (Moscow), v. 33, no. 26, 1960 p 22–26 (See N68-32058 19-30)

Evaluation of polarimetric observations on comet Arend-Roland indicate a material discharge from its nucleus in two opposite directions. Polarization in various parts of the comet seems to be combined with a regulated motion of the solid particles that reflect the sun light. Measurements of optical densities for points of equal emission show changes of polarization with time. G.G.

N68-32062# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SOME NEW DATA ON THE STRUCTURE OF CHONDRITES
L. G. Kvasha *In its* Astron. Papers Transl. from the Russian, Pt. 1 28 Nov. 1962 p 13–28 refs Transl. into ENGLISH from Meteoritika (Moscow), v. 20, 1961 p 124–136 (See N68-32058 19-30)

Microscopic comparison of metallic particles and silicates in chondrites which differ in structure and metal iron content established the presence of nickel–iron fragments similar in structure to the iron framework of pallasites. A graphic analysis of crystal opticals constants for the Vavilov meteorite confirmed the equimolecularity of olivine and rhombic pyroxene. G.G.

N68-32063# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DETERMINATION OF RELATIVE gf-VALUES OF CHROMIUM (Cr I)
L. A. Mitrofanova *In its* Astron. Papers Transl. from the Russian, Pt. 1 28 Nov. 1962 p 29–33 refs Transl. into ENGLISH from Izv. Glavnol. Astron. Observ. (Pulkovo), v. 19, no. 152, 1954 p 100–102 (See N68-32058 19-30)

Arc produced excited chromium atom spectrograms were evaluated for their gf-values by employing the following formula: $\log I\lambda^3/gf = C - 5040/T\ E_m$; where I = relative intensity of line; λ = wavelength in angstroem units; g = statistical weight; f = oscillator strength; T = excitation temperature of the arc; E_m = excitation potential of the upper level; and C = constant. Obtained results agreed well with those from other sources. G.G.

N68-32064# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STELLAR MODELS FOR THE MAIN SEQUENCE WITH THE ABSORPTION LAW $k = k_0 \rho^{0.875} T^{-3.5}$
A. G. Massevich, V. P. Mateeva, and L. N. Tulenkova *In its* Astron. Papers Transl. from the Russian, Pt. 1 28 Nov. 1962 p 35–52 refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 28, 1951 p 432 (See N68-32058 19-30)

We examined in detail the calculations of a model of a star with a convective core for an absorption law of the form $k = k_0 \rho^{0.875} T^{-3.5}$, the properties and characteristics features of such a model, and compared it with earlier calculations for various k. The application to real existing stars shows, first, that the model with a convective core fits only stars of the main sequence and cannot well explain the large radii of giants and subgiant stars, even if we take into consideration a possible change in the ratio of the mean molecular weight of the envelope to the convective core. Secondly, even within the limits of the main sequence itself it is necessary to take into account a change in the absorption law along the sequence, since the model with one fixed k cannot explain all stars of the main sequence (not to speak of the physical aspect of the effects). The calculated data obtained in the second part of the present work will be used for an examination of possible tracks of evolution of hot giant stars of the main sequence. Author

N68-32078*# Harvard Coll. Observatory, Cambridge, Mass.
ABSOLUTE GF-VALUES FOR Fe(1) and Fe(2) LINES
Gary L. Grasdalen, Martin Huber, and W. H. Parkinson Apr. 1968 79 p refs
(Grant NsG243B; Contract Nonr-1866(48))
(NASA-CR-95970; SR-27; AD-671019) CSCL 03B

Absolute gf-values for 34 lines of Fe I and 12 lines of Fe II were determined along with Van der Waals broadening coefficients. The relative and absolute scales of published gf-values are considered. Author (TAB)

N68-32094*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXPLICIT UPPER BOUNDS FOR ERROR PROPAGATION IN THE N-BODY FIELD

Albert Rosen Washington Aug. 1968 18 p refs

(NASA-TN-D-4511) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A simple means for bounding the propagated trajectory error induced by an impulsive initial error in the n-body field is developed. Formulas are derived for the maximum acceptable initial error, given the mission tolerances, and for the maximum time of negligible propagated error, given the initial impulses and mission tolerances. An example illustrates the use of the results within the solar system. Author

N68-32160*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

MILESTONE REPORT OF A STUDY OF SPACE MISSION DURATION EXTENSION PROBLEMS, VOLUME 1

Roy B. Carpenter, Jr. 15 Apr. 1967 102 p refs

(Contract NAS8-18025)

(NASA-CR-73236; SID-67-478-1, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Mission requirements, maintenance and repair constraints, and crew capabilities and constraints are detailed in terms of problems related to extended space missions. Mission safety and success aspects were considered for a representative manned Mars flyby mission of 690 days and a baseline spacecraft composed mainly of subsystems that are Apollo derivatives. Constraints considered include spacecraft stability and velocity control; atmospheric pressure; oxygen, nitrogen, and carbon dioxide systems; and trace contaminant, temperature, and humidity controls. References for downtime constraints are given. Crew constraints studies were concerned with force production on one G versus zero G, force production in reduced gravity, tractionless environment, dexterity impediments and working conditions, and task time decrements. References for crewman capabilities and constraints are included. M.W.R.

N68-32161*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

MILESTONE REPORT OF A STUDY OF SPACE MISSION DURATION EXTENSION PROBLEMS, VOLUME 2

Roy B. Carpenter, Jr. 15 Apr. 1967 126 p

(Contract NAS2-4214)

(NASA-CR-73237; SID-67-478-2, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Capability of spacecraft subsystems to function on a manned Mars flyby mission of 690 days were studied. A computer simulation program developed in conjunction with these studies is presented, and note is made of potential problem areas requiring additional investigation. Details are included for the spin engine subsystems, as well as for the reaction control, main engine, and environmental control/life support subsystems. The electrical power system, structures subsystem, and integrated electronics required for the extended space mission are also considered. In addition to subsystem reliability evaluations, each mission function was examined from the point of view of criticality and alternate equipment use. Mission success, defined as the accomplishment of all objectives with safety for crew, was considered in determining the dependence on the individual functions; and a functional description of the baseline mission is included that emphasizes the phases from "Perform Interplanetary Injection" through "Perform Earth Retro". M.W.R.

N68-32162*# North American Rockwell Corp., Downey, Calif. Space Div.

A STUDY OF SPACE MISSION DURATION EXTENSION PROBLEMS, VOLUME 3

Roy B. Carpenter, Jr. 30 Oct. 1967 350 p refs

(Contract NAS2-4214)

(NASA-CR-73238; SID-67-478-3, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Ability of contemporary hardware to meet the requirements and constraints imposed on systems by long duration space missions was studied using the availability concept as a design tool. Emphasis was on selecting a mission concept that showed promise of achieving a safe and effective planetary flyby and return and the availability concept permitted a safe and reasonable balance between systems and mission performance, reliability, maintainability, and operability. Mission operations and crew safe return are discussed in terms of navigation, gravity, profile complexity, and abort capability; and a maintenance requirements estimation concept considers allocation of spares and the equalizing of risk within a function. Crew critical subsystems analysis and other criticality subsystems are detailed. This concludes attention to environmental control and life support systems, attitude and stability control systems, reaction control engines, and up-date link system; as well as to the propellant management system, main propulsion engine, guidance and navigation, electrical power, and central timing. Spinup and despin and precess control functions are described, as are the communications/data, and antenna systems. M.W.R.

N68-32171# Ludwig-Maximilians-Universitat, Munich (West Germany). Geophysical Observatory.

RESULTS OF OBSERVATIONS CONDUCTED AT THE GEOMAGNETIC OBSERVATORY FUERSTENFELDBRUCK IN 1967 [ERGEBNISSE DER BEOBACHTUNGEN AM ERDMAGNETISCHEN OBSERVATORIUM FUERSTENFELDBRUCK IM JAHRE 1967]

1968 53 p refs In GERMAN *Its* Series A, No. 10

CFSTI: HC $3.00/MF $0.65

Continuous registrations of the geomagnetic parameters of declination, horizontal intensity, and vertical intensity are reported for the Year 1967. All geomagnetic pulsations were obtained by induction variometers and statistical evaluation and are shown in table forms. Transl. by G.G.

N68-32181# National Research Council of Canada, Ottawa (Ontario).

RADIO OBSERVATIONS OF THREE SUSPECTED TYPE 2 SUPERNOVA REMNANTS [RADIONABLYUDENIYA TREKH PREDPROLAGAEMYKH OSTATKOV USPYSHEK SVERKHNOVYKH 2 TIPA]

N. V. Bystrova, I. V. Gosachinskii, T. M. Egoroga, and N. F. Ryzhkov 1968 11 p refs Transl. into ENGLISH from Izv. Gl. Astron. Observ. Pulkovo (USSR), v. 24, no. 178, 1965 p 202–205

(NRC-TT-1323) CFSTI: HC $3.00/MF $0.65

The results are given of observations of the extended non-thermal radiosources W44, W28, W14, made with the Pulkovo large radio telescope. The polar diagram at the declinations of the sources is $7' \times 1.^{\circ}5$, $7' \times 4.^{\circ}5$ and $7' \times 0.^{\circ}8$, respectively, at the 21 cm wavelength. The brightness distribution in the continuum along the sources is not in agreement with the space model assuming a thin spherically symmetric shell. Transit curves in some frequencies of the neutral hydrogen line profile are given. The possible upper limit of the distance to the sources estimated. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-30903# Institut d'Aéronomie Spatiale de Belgique, Brussels.
TABLES OF ARTIFICIAL SATELLITES 1957–1967 [TABLEAU DES SATELLITES ARTIFICIELS 1957–1967]
J. Vercheval 1968 74 p refs In FRENCH; ENGLISH Summary *Its* Aeronomica Acta F-11-1968 CFSTI: HC $3.00/MF $0.65

After a record of space launchings, three tables are established about the types of satellites, individual satellites and the American secret satellites. Finally, the chronology of manned space flights and the emission frequencies of the most important satellites are presented. Author (ESRO)

N68-30904# Hawker Siddeley Dynamics, Ltd., Hatfield (England). Space Projects Div.
ELDO TASK DEFINITION NO. 3.5: A PRELIMINARY STUDY OF ELDO B SATELLITE LAUNCHING VEHICLES. PART 1: OVERALL SUMMARY AND PERFORMANCE
Jan. 1966 95 p refs Prepared for ELDO jointly with R.A.E. CFSTI: HC $3.00/MF $0.65

Defines second generation ELDO launch vehicles, ELDO E-1 (Blue Streak plus one hydrogen-oxygen stage) and ELDO B2 (Blue Streak plus two hydrogen-oxygen stages) discussing optimum characteristics - and performances - relating to mission requirements. ESRO

N68-31074# American Science and Engineering, Inc., Cambridge, Mass.
ANALYSIS OF SATELLITE DATA
Frank R. Paolini and George C. Theodoridis 31 May 1968 77 p refs *Its* Spec. Sci. Rept. No. 1
(Contract F19628-67-C-0277)
(ASE-1887; AFCRL-68-0301; AD-671177)

Results of the theoretical work on the characteristics of the electrostatic analyzer and of advanced analysis of data from the satellite Hitch-hiker I are presented. Plans for future work are briefly outlined. As a continuation of the analysis of the Hitch-hiker I energetic electron data, a radiation belt model has been developed which is based on the simultaneous presence of two types of diffusion processes, one of which conserves the first adiabatic invariant while the other conserves the particle energy. A computer program has been developed, simulating the radiation belts under certain simplifying assumptions. Preliminary results approximate well the temporal and spatial patterns observed in the radiation belt. Analytical results have also been obtained, but their usefulness has so far been rather limited due to certain restrictive underlying assumptions. Author (TAB)

N68-31121# European Space Operations Center, Darmstadt (West Germany).
OPERATIONS PLAN FOR ESRO 2, VOLUME 1
I. Rodger, ed. Paris ESRO Jan. 1968 33 p
CFSTI: HC $3.00/MF $0.65

The spacecraft carries experiments to make the following measurements: X-rays and corpuscular radiation from the sun, flux and energy spectra of cosmic ray particles, including primary electron, and radiation belt particles. An operational organigram including the ESRO 2 operation management and the control center responsibilities is set up, and a description is made of the data acquisition and tracking network. ESRO

N68-31123# Hawker de Havilland Australia Pty. Ltd., Lidcombe.
BLACK ARROW LAUNCH PROCEDURES
J. S. Saywell [1968] 10 p Presented at the 1st Ann. Meeting of the Brit. Interplanet. Soc., Southampton, 23–25 Apr. 1968
CFSTI: HC $3.00/MF $0.65

The procedure of testing the different elements and the various electronic sub-assemblies of the Black Arrow satellite launching vehicle to be fired at Woomera, South Australia is summarized. Vehicle preparation and final checks performed in Australia are described together with the facilities available on the site. Indications are given on the live firing operations and emergency action if necessary. ESRO

N68-31161# Hawker Siddeley Dynamics, Ltd., Hatfield (England). Space Projects Div.
ELDO FUTURE PROGRAMS: STUDY NO. 3.6. THE DEFINITION AND DEVELOPMENT POTENTIAL OF BLUE STREAK FOR ELDO B TYPE LAUNCHERS
Nov. 1965 183 p refs Prepared for ELDO
(HSD-TP-7022) CFSTI: HC $3.00/MF $0.65

Discusses the development potential of Blue Streak as a first stage in ELDO B launch vehicle configurations, where one or two upper stages are liquid hydrogen, liquid oxygen engines. The modifications in design, control systems, tank pressurization, thrust, ground equipment for the first stage, required by each configuration are examined. ESRO

N68-31198# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
MOUNTING AND ACCEPTANCE TESTS OF A SOUNDING ROCKET PAYLOAD [INTEGRATION ET RECEPTION D'UNE TETE DE FUSEE]
V. Hantcherian Mar. 1967 23 p In FRENCH Presented at the School on the Technol. of the Space Expt. Sponsored by the CNES
CFSTI: HC $3.00/MF $0.65

Tests performed on sounding rocket payload components are described as well as tests carried out after assembling of all components. ESRO

N68-31201*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
VOYAGER TERMINAL GUIDANCE STUDY FINAL REPORT
G. W. Coyne and D. E. Ward Jul. 1968 38 p refs
(Contract NAS8-21168)
(NASA-CR-61909; HREC-1168-1; LMSC/HREC-A791673) CFSTI: HC $3.00 /MF $0.65 CSCL 22B

The results of an analysis to determine the performance capability and orbit insertion accuracy of the Voyager spacecraft, utilizing constant inertial attitude guidance, to accomplish the deboost maneuver into a terminal orbit about Mars were presented. The performance capability of the nominal vehicle was obtained by generating nominal trajectories which accomplished transfers from the nominal class of hyperbolas specified by hyperbola specific energy into the nominal terminal orbit. The fraction of the initial vehicle mass which was delivered into the terminal orbit (performance) was found to be a function of the rotation angle between hyperbola and ellipse periapsis, as well as the difference in periapsis altitude. The optimum performance occurs for a periapsis to periapsis transfer in which hyperbola periapsis altitude is the same as that of the desired ellipse. The deboost error analysis was accomplished by choosing representative nominal trajectories and applying correlated ignition position and velocity errors (navigation errors) and independent, normally distributed execution errors. This was done by means of a specially developed Monte Carlo deboost system error analysis program which samples the postulated error spaces for each Monte Carlo pass, and generates the statistics of the terminal orbit errors. Author

N68-31216# British Aircraft Corp., Preston (England).
THE BLACK ARROW AS A VEHICLE FOR TESTING ADVANCED STRUCTURES
D. Pritchard-Jones [1968] 15 p refs Presented at the 1st Ann. Meeting of the Brit. Interplanet. Soc., Southampton, 23–25 Apr. 1968
CFSTI: HC $3.00/MF $0.65

Structural principles of a combined booster-spacecraft module are examined. It is shown that flight research models are necessary to investigate aerodynamic and structural problems especially the reusability of the structure. The possibility of using the 'Black Arrow' as launch vehicle for these models is discussed. ESRO

N68-31221# European Space Technology Center, Noordnijk (Netherlands).
ADVANCED STUDY OF A COSMIC RAY SATELLITE SYSTEM
Mar. 1968 131 p
CFSTI: HC $3.00/MF $0.65

A study is made of a cosmic ray satellite with the principal aim to define a reasonable technical solution to meet the requirements imposed by the gamma-ray and X-ray experiments. On the basis of the technical definition, a preliminary cost estimate has been made. A practical and desirable approach to the main principles of the project, e.g. satellite orbit, control and stabilization is presented. The approach chosen shows a great design similarity at satellite subsystem level, in the stabilization, power, telecommunications and data subsystems, between the cosmic ray satellite proposed and the TD/1 satellite. This should not imply that the same components and engineering methods will be used. However, unusual details of such features as component and subsystem performance, operation, weight and power estimation are available at a very early stage in the definition. Author (ESRO)

N68-31244# Hawker Siddeley Dynamics, Ltd., Hatfield (England). Space Projects Div.
ELDO TASK DEFINITION NO. 3.5: A PRELIMINARY STUDY OF ELDO B SATELLITE LAUNCHING VEHICLES. PART 2: APPENDICES
Sep. 1965 229 p refs Prepared for ELDO Jointly with R.A.E.
CFSTI: HC $3.00/MF $0.65

A selection is made of possible structures for the final stage of ELDO B vehicle. The basic engine considered has a total usable propellant mass of 5.5 tons and utilizes a single engine unit of 6.0 tons thrust. The design, performance and operation of this engine in a typical flight plan required to place a satellite in synchronous orbit is considered in some detail. Other problems, such as propellant supply and tank pressurization, meteoroid protection insulation, control, guidance, telemetry, power supplies, checkout and safety systems are outlined. ESRO

N68-31261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF CYLINDRICAL ELECTROSTATIC PROBE MEASUREMENTS ON ALOUETTE 2 AND EXPLORER 31 SATELLITES
L. H. Brace and J. A. Findlay Jun. 1968 24 p refs
(NASA-TM-X-63292; X-621-68-215) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Alouette II and Explorer 31 satellites were placed in orbit by a single vehicle and separated. Cylindrical electrostatic probes were employed on both satellites in part to test the effects of the long sounder antennae and large radio frequency power upon direct measurements of the thermal electrons and ions. Comparison of the early data taken when the satellites were separated less than 1000 kilometers along their common orbit suggest that there is no inherent incompatibility between the sounder experiment and direct measurement experiments. The electron temperature (T_e) and concentration (N_e) derived from the two experiments generally agree to better than 10% although unexplained differences of up to 15% in T_e and 40% in N_e have been found on rare occasions. Author

N68-31477*# Boeing Co., Seattle, Wash.
LUNAR ORBITER 2: EXTENDED MISSION SPACECRAFT OPERATIONS AND SUBSYSTEM PERFORMANCE
NASA Aug. 1968 158 p CSCL: 22B
(NAS1-3800)
(NASA-CR-1141; D2-100752-4, V. 4) CFSTI: HC $3.00/MF $0.65

The Lunar Orbiter II spacecraft was tracked from the start of its extended mission until it was intentionally crashed on the Moon. Following this launch, Lunar Orbiter II was used primarily for Doppler and ranging calibrations. Selenodetic data that could be used in developing a lunar gravitational model that would be more meaningful were obtained by changing the Lunar Orbiter II orbit inclination from 11.9 to 17.6 degrees at the beginning of the extended mission. Lunar environmental events of significance were proton events indicated by telemetry. Looper radiation increased 39 rads during the first event and 32.5 rads during the second. Seven micrometeoroid hits were recorded during the extended mission. Special tests were conducted to obtain additional data on performance characteristics of the various subsystems with the spacecraft in unique attitudes and/or environmental configurations. Author

N68-31503# Royal Aircraft Establishment, Farnborough (England).
CECLES LAUNCHER— EUROPE I F.5 VEHICLE LAUNCHING OF 15TH NOVEMBER 1966. FINAL REPORT ON THE SECOND STAGE [LANCEUR CECLES — EUROPE I VEHICULE F.5 TIR DU 15 NOVEMBRE 1966. RAPPORT DEFINITIF SUR LE DEUXIEME STAGE]
1967 99 p Transl. into ENGLISH from Nord Aviation Rept. 112/67
(RAE-LIB-TRANS-1271) HC $3.00/MF $0.65

A number of reports issued by the various authorities associated with the evaluation of the 2nd stage performance of the ELDO launching vehicle are presented. The analysis of the trials objectives and ground support for the second stage of the F.5 vehicle form the basis of these reports. The records of the important separation phase between the first and second stages showed that the vehicle behaved as predicted although there was telemetry signal loss because of flame attenuation. The main troubles encountered during the progress of the launch were the failures to receive information by the telemetry and the lack of personnel acquainted with the problems especially ground equipment faults. Author

N68-31978*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DYNAMIC CHARACTERISTICS OF SATELLITES HAVING LONG ELASTIC MEMBERS
Harold P. Frisch Washington Aug. 1968 42 p refs
(NASA-TN-D-4576) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Many satellites, such as ATS-A, ATS-D, DODGE, RAE, etc., have clamped to the surface of their central body long elastic members which when set into vibratory motion can significantly influence the motion of the central body. If such a satellite is reasonably symmetrical, we can predict its dynamic characteristics by modeling the entire satellite as a symmetric double-beam system: that is, by a rigid symmetric central body having clamped to its surface two long, diametrically opposed uniform elastic beams with tip weights possessing identical physical and geometrical

properties. In this paper, dimensionless equations which define the natural modes and frequencies of such a satellite system are derived and solved. The solutions are outlined in graphical form and then used to solve the equations that describe the elastic response of the satellite to an arbitrary periodic forcing function. The results in both graphical and analytical form make it possible to predict with slide-rule accuracy the natural frequencies of any satellite that can be modeled as a symmetric double-beam system. Author

N68-32027# Santa Barbara Research Center, Goleta, Calif.
MULTI-ORDER SATELLITE IR GRATING SPECTROMETER (SIRS B), VOLUME 1 Final Report, Mar.–Oct. 1967
J. C. Reed 27 Oct. 1967 218 p refs
(Contract E-132-67(N))
(PB-178122) CFSTI: HC $3.00/MF $0.65

The report describes the development and design effort accomplished during the period of March through October 1967, and is concerned with the Optical and Mechanical unit for the Satellite Infrared Spectrometer (SIRS-B). The report does not include the primary electronics effort which is being accomplished on a separate contract. Phase 2, covering the fabrication effort, will be described in later reports. The SIRS-B is a subsystem for the Nimbus D meteorological satellite being developed for the National Aeronautics and Space Administration by the National Environmental Satellite Center (NESC). The satellite is scheduled to be launched during the second half of the calendar year 1969. USGRDR

N68-32087*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SNAP-19/NIMBUS B INTEGRATION EXPERIENCE
Arthur W. Fihelly, Herbert N. Berkow (Hittman Associates, Inc.), and Charles F. Baxter Aug. 1968 28 p refs
(NASA-TM-X-63300; X-450-68-268) CFSTI: HC $3.00/MF $0.65
CSCL 22B

Described are SNAP-19/Nimbus B integration efforts and major interface problems. The NASA specification requirements are reviewed and problems attendant to their implementation are explored. In this program, aerospace nuclear safety considerations were found to impose the greatest restrictions both on design and integration. The importance of complete user specifications and nuclear safety evaluations early in the program is emphasized. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-30883 IIT Research Inst., Chicago, Ill.
A THREE DIMENSIONAL DYNAMIC PHOTOELASTIC INVESTIGATION OF STRESS WAVE PROPAGATION IN CONES
Lia Vodja Brillhart (Ph.D. Thesis) 1967 221 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-12503

A method that may be used to investigate dynamic stress wave propagation in three-dimensional models has been established. The method consists of photographing, at a high framing rate, the isochromatic fringe pattern due to a stress wave propagating in an isolated slice representing a plane in the model. The slice isolation is accomplished by means of an embedded polariscope. A Cranz-Schardin multiple spark camera is employed to photograph the dynamic fringe pattern. In order to demonstrate the feasibility of the developed method, stress wave propagation in a cylinder and in cones of various apex angles was studied. The stress wave has been found to consist of a long wavelength primary pulse followed by a series of short wavelength trailing pulses. The decay rate of the maximum fringe order associated with the primary pulse has been established as a function of the cone apex angle. An analysis has also been performed to qualitatively determine the effect of attenuation, dispersion, change in cross-sectional area and three-dimensionality of the stress field on the decay rate of the maximum fringe order in the primary pulse. Dissert. Abstr.

N68-30933 Office National D'Etudes et de Recherches Aerospatiales, Paris (France).
STRUCTURE CHARACTERIZATION BY THE GREEN METHOD WITH THE OBJECT OF PREVIEWING THE VIBRATOR EFFECTS DUE TO A DIVIDED, UNCERTAIN ENVIRONMENT [CARACTERISATION DES STRUCTURES PAR UNE METHODE DE GREEN EN VUE DE LA PREVISION DES EFFETS VIBRATOIRES DUS A UN ENVIRONMENT ALEATOIRE REPARTI]
A. Bourgine [1968] 23 p refs In FRENCH Presented at Aeron. Acoust. Symp., Toulouse, 6–8 Mar. 1968
CFSTI: $3.00

In calculating the static characteristics of the vibration response of a structure, subjected to random excitation on all or part of its boundary, equations are formulated to characterize the environment and the structure. It is assumed that the spatial–temporal correlations of the pressures exerted by the ambient environment on the structure, and the vibration characteristics of the structure are known. Parameters are estimated for the medium frequencies, spectral power density of the response, and the spectral mean density for a band of frequencies. A generalized Green's function is proposed as a global approach to characterizing structures and predicting the effects of acoustic environments. Transl. by M.G.J.

N68-30938 Polytechnic Inst. of Brooklyn, N. Y.
INTERACTION OF A RING-REINFORCED SHELL AND A FLUID MEDIUM
Jerry W. Berglund (Ph.D. Thesis) 1967 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-13377

Consideration is given to the transient dynamic response of a periodically ring-reinforced, infinitely long, circular cylindrical shell to a uniform pressure suddenly applied through the surrounding acoustic medium. The incident particle velocity is zero and the rings are assumed to be slightly flexible. A classical theory of the Donnell type is used to analyze the shell while the fluid is described by the linear acoustic field equation. The solution is obtained by assuming a power series expansion in the ring stiffness parameter and utilizing a technique which reduces the transient dynamic problem to an equivalent steady-state formulation. Numerical results are presented for a steel shell immersed in salt water for different ring spacings. Dissert. Abstr.

N68-30990 Texas Univ., Austin.
ANALYSIS OF INPLANE T, Y, AND K WELDED TUBULAR CONNECTIONS
Luther Alton Beale, Sr. (Ph.D. Thesis) 1967 207 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-14796

This dissertation reports the results of a series of experiments performed on welded connections between steel tubes. The exploration was directed toward determining the distribution and magnitudes of local stresses occuring in such joints when the joined members are subjected to axial loadings. Ten full size specimens

representative of welded joints used in practice were tested. Seven of the specimens involved a single brace (small tube) framing onto the unbroken surface of a chord (larger tube). The remaining three specimens were joints with multiple (3) braces joining to the surface of the chord. The stresses at critical points in the joint were monitored from electrical resistance strain gages located on the surfaces of the tubes. Because the dimensional parameters for the T-joints were systematically varied from specimen to specimen, their individual influence on the stresses could be quantitatively appraised. Dissert. Abstr.

N68-31015 Syracuse Univ., N. Y.
ON THE DYNAMIC STABILITY OF ECCENTRICALLY REINFORCED CIRCULAR CYLINDRICAL SHELLS
Werner Konrad Dietz (Ph.D. Thesis) 1967 181 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-12061

An analytical investigation of dynamic buckling of eccentrically reinforced circular cylindrical shells is carried out. A new set of field equations (equilibrium and compatibility) is derived on the basis of large deflection theory. The theory is applied to a clamped reinforced shell which is loaded axially by a controlled rate of endshortening. Dynamic equilibrium is satisfied in the sense of Bubnov-Galerkin which leads to a system of two second order differential equations of the third degree in the checker-board and diamond buckling pattern amplitudes. For static rates of endshortening, $\gamma = 0$, and imperfections of the order of manufacturing tolerances, it is shown that the predicted buckling load is in good agreement with the reported static value. An eighth order linear Donnell-type buckling differential equation is derived also and then applied to the shell under consideration. The concept of stiffener location effectiveness is introduced within the scope of linear classical theory and the assumption of equal mode numbers for both reinforcement locations. Dissert. Abstr.

N68-31058 IIT Research Inst., Chicago, Ill.
DYNAMIC THERMAL SHOCK IN SPHERICAL SHELLS
Thomas A. Zaker (Ph.D. Thesis) 1967 98 p
Available From Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-14566

A method is developed for the solution of problems of uncoupled dynamic thermoelasticity with arbitrarily prescribed spherically symmetric temperature fields. The technique is based on an integration theorem for hyperbolic initial-value problems, together with the construction of image temperature fields in regions outside the actual body so as to satisfy stress or displacement boundary conditions at surfaces. The image technique is applied to problems of internal thermal shock in spherical shells of arbitrary thickness, both with stress-free and with fixed isothermal external boundaries. The published closed-form solution of the associated simpler problem of thermal shock on a cavity in an infinite solid, which had been obtained by other investigators using transform techniques, is recovered as a special case. Numerical results for the cavity and unrestrained shell problems are presented, and are compared with those obtained by other techniques. It is shown that the image method resolves accurately the details of the dynamic response at early times in these problems. Dissert. Abstr.

N68-31103# Pennsylvania State Univ., University Park. Ordnance Research Lab.
RADIATION PROPERTIES OF CELLULAR SHELLS
J. J. Gavigan Jul. 1967 32 p
(Contract NOw-65-0123)
(TM-619.3111-07; AD-671042)

The differential equations of motion governing the elastic response of the cellular shell submerged in an infinite acoustic medium are derived from the Lagrangian of the system by use of Hamiltons Principle. Solutions for the far-field scattered pressure are obtained by use of the asymptotic expansion of Hankal Functions. Numerical results are presented for the non-dimensional far-field pressure in water for frequency parameters of 0.05 to 10.0 over a wide range of various geometric ratios which determine the structure of the shell. Author (TAB)

N68-31129# Pennsylvania State Univ., University Park. Ordnance Research Lab.
VIBRATION AND WAVE PROPAGATION IN CYLINDRICAL SHELLS
E. M. Frymoyer Aug. 1967 225 p refs
(Contract NOw-65-0123)
(TM-106.2811-05; AD-671038)

The generalized approximate equations of motion of a cylindrical shell are developed. The long wavelength, low frequency approximation is shown to be the zero order or Flugge approximation. The characteristics of the mode dispersion spectrum are investigated as a function of frequency for the first few roots for orders zero to four, including real, imaginary and complex wave numbers. The dependence of the complex and imaginary branches on shell geometric factors of thickness and radius are presented. Comparison is made to three-dimensional elasticity analysis and to Mirsky-Herrmann theory. The change from thin to thick shell behavior for the complex branch or end modes is traced. The radial displacement conditions for various end conditions of a thin cylindrical shell are given. Expressions are also given for the various shell impedances. Author (TAB)

N68-31145# Polytechnic Inst. of Brooklyn, N. Y. Aerospace Engineering and Applied Mechanics Dept.
RING-STIFFENED ORTHOTROPIC CIRCULAR CYLINDRICAL SHELL UNDER HYDROSTATIC PRESSURE
Joseph Kempner, A. P. Misovec, and F. C. Herzner May 1968 131 p refs
(Contract Nonr-839(39))
(PIBAL-68-10; AD-670519)

A ring-reinforced, orthotropic circular cylindrical shell subjected to external hydrostatic pressure loading is investigated. The stresses and deflections throughout the shell are determined by a shell theory which considers the combined and separate effects of large rotations, transverse shear deformation, initial deflections and Flugge type thickness terms. The ring deformations are described by both a deep ring theory and a plane strain analysis. The results are used in the development of pertinent design formulae. Numerical results applicable to a typical glass-reinforced-plastic shell indicate that the nonlinear effects may be accurately provided for by using a perturbation solution. Hills criterion for yielding of an orthotropic material as well as an analysis to approximate the actual stresses in the constituent materials of a nonhomogeneous shell are also applied. Author (TAB)

N68-31146# California Univ., San Diego. Aerospace and Mechanical Engineering Sciences Dept.
OPTIMAL PLASTIC DESIGN OF CIRCULAR AND ANNULAR SANDWICH PLATES WITH PIECEWISE CONSTANT CROSS SECTION
C. Y. Sheu and W. Prager Jun. 1968 17 p refs
(Contract N00014-67-A-0109-0003)
(TR-18; AD-671197)

Hopkins and Prager used an intuitive approach based on the concept of competing yield mechanisms to discuss plastic minimum-weight design of a circular plate with piecewise constant cross section. Since their paper was written, the theory of optimal plastic design has progressed considerably, but subsequent papers on optimal plate design were exclusively concerned with plates of continuously varying cross section. In view of the lesser manufacturing cost of plates with piecewise constant cross section, the present paper reexamines the problem in the light of the

modern theory of optimal plastic design. General optimality criteria are established and applied to full circular as well as annular plates. The relation of the designs obtained for annular plates to the singular designs investigated by Megarefs is discussed. Author (TAB)

N68-31158# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
DESCRIPTION OF THE PLANE STRESS AND PLANE STRAIN SOLUTIONS TO PLATES WITH VARIOUS SIZED CIRCULAR HOLES: COMPUTER PROGRAM (NMP 881)
J. P. Yalch Dec. 1967 67 p refs
(Contract AT(40-1)-2847)
(GEMP-598) CFSTI: HC $3.00/MF $0.65

Described is a Fortran IV computer program, plane-stress and plane-strain solutions to plates with various sized circular holes, (NMP 881), based on the method described in a report by T. Slot. This method is suitable for the solution of two-dimensional problems that involve solid or perforated plates with boundary conditions in terms of stresses, displacements, and/or forces. The perforations must be circular but may vary in size. Author (NSA)

N68-31191# Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux (France).
A THEORY OF NON-ELASTIC SHELLS [UNE THEORIE DES COQUES HORS DU DOMAINE ELASTIQUE]
Roger Valid 1968 11 p refs In FRENCH Presented at the Assoc. Tech. Maritime et Aeron., Paris, 6–10 May 1968
(ONERA-TP-573 CFSTI: HC $3.00/MF $0.65

A general theory of shells of any shape presenting great shift and deformation is presented. It is assumed that solutions comply with the Kirchhoff–Love hypothesis. Equilibrium equations, necessary and sufficient for such hypothesis show that the shell is submitted to only planar stresses, even in the non-elastic field. Kinetic compatibility conditions are expressed in a simple form. The hypotheses are generalized to take into account thickness variation and twisting of normals. The theory leads to a method of calculation after introduction of a differential law of behavior. ESRO

N68-31213 IIT Research Inst., Chicago, Ill.
TOPICS ON STRESS FUNCTIONS IN CONTINUUM MECHANICS AND EXACT SOLUTIONS IN FINITE ELASTICITY
Karl W. Schuler (Ph.D. Thesis) 1967 141 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-14565

A complete stress function solution to the equilibrium equations of a continuous medium is developed. This result generalizes the Beltrami stress function and overcomes the lack of completeness. The proof of the completeness of the generalized Beltrami stress function is facilitated by establishing a representation theorem which provides for the decomposition of an arbitrary symmetric second order tensor into a tensor and vector potential. The deformation fields possible in every isotropic homogeneous incompressible elastic material are investigated. Particular attention is paid to deformation fields which have constant principal strain invariants. Plane deformation fields with superimposed transverse stretch and radially symmetric deformation fields are considered. For both of these, the complete class of exact solutions appropriate to the assumption of constant strain invariants is determined. Dissert. Abstr.

N68-31219# British Hovercraft Corp., Ltd., East Cowes (England).
BLACK ARROW STRUCTURAL DESIGN AND TESTING
C. T. Maidment and J. Nicholls 24 Apr. 1968 29 p Presented at the 1st Ann. Meeting of the Brit. Interplanet. Soc., Southampton, 23–25 Apr. 1968
(SP-1986) CFSTI: HC $3.00/MF $0.65

An introduction and general description of the 'Black Arrow' configuration, particularly the two stages, are given. Structural loading and the dynamic structural stability are considered and three structural test specimens are described. Functional testing carried out in the early development of the vehicle is considered. ESRO

N68-31267*# Mathematical Research, Inc., Houston, Tex.
METHODS OF THE GALERKIN TYPE
[1967] 108 p refs
(Contract NAS9-6964)
(NASA-CR-92216) CFSTI: $3.00 CSCL 20K

Approximation theory is considered in relation to Galerkin-type methods, and a classification of such methods is given with existing convergence theorems. The definition of an optimal approximation to the exact solution is discussed, and a problem is considered which is subject to homogeneous boundary conditions and in which there is a self-adjoint linear operator defined in a separable Hilbert space. Selecting the optimal sets of coordinate functions and weight functions for the method of weighted residuals is investigated. A related method for solving such a problem is presented, and proof is offered that it is an optimal method that also converges. The Galerkin method and the method of weighted residuals is applied to the solution of three types of problems in which the operator is linear, self-adjoint, and positive definite; and in one of the problems the operator is also bounded and, therefore, continuous. The use of the Galerkin method in nonlinear situations is also shown. Various applications reported in the literature are included, with author, title, and a short note in each case. M.W.R.

N68-31269 Pittsburgh Univ., Pa.
BUCKLING OF A REINFORCED CONICAL SHELL
Jack William Fisch (Ph.D. Thesis) 1967 259 p
Available from Univ. Microfilms: HC $11.70/MF $3.35 Order No. 67-12389

Equilibrium and stability equations are developed for the general instability of a grid reinforced truncated conical shell. The equations include the effects of the prebuckling forces, the transverse shear forces, and the inequality of the in plane shear forces. While the equations are developed in detail for the case of a constant thickness shell with equally spaced and constant cross section stiffeners, the theory can be applied to any variation of shell thickness, stiffener spacing, and stiffener cross section. Specifically, the case of a tapered shell, where all dimensions vary linearly with the distance from the cone apex, is also developed. The equilibrium equations are developed from a force balance on a buckled element of the shell. The stability equations (derived from the equilibrium equations by the Galerkin method) are solved for the case of normal pressure and axial compressive load by means of approximate deflection functions and correction factors. A method is also developed for the determination of the active portion of the shell. Dissert. Abstr.

N68-31288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON TWO KINDS OF DIFFERENCE METHODS FOR THE BENDING PROBLEM OF RECTANGULAR CANTILEVER PLATES
Nien-Tseng Sun, Wan-Ch'i Chang, Chih Kuan, and Ching-Liang Ch'en 30 Jun. 1967 25 p refs Transl. into ENGLISH from Ch'ing Hua Ta Hsueh Hsueh Pao (Chinese People's Rep.), v. 12, no. 1, 1965 p 45–62
(FTD-HT-67-380; AD-671135)

The paper discusses two kinds of iterative methods which can be used in practice to solve the difference equations corresponding to the bending problem of rectangular contilever plates. One of them is a variant of the two line successive overrelaxation method, and the other is an alternating direction implicit method. The numerical results of an example are presented to demonstrate the applicability and efficiency of these methods. Author (TAB)

N68-31292*# Techtran Corp., Glen Burnie, Md.
SYNTHESIS OF THE SPATIAL MECHANISMS OF A LANDING GEAR WITH AN "ARTICULATED LEG" [SINTEZ PROSTRANSTVENNYKH MEKHANIZMOV SHASSI S "LOMAYUSHCHEYSYA NOGOY"]
V. D. Ivanov Washington NASA Jun. 1968 13 p refs Transl. into ENGLISH from Mekhan. Mashin (USSR), v. 11, 1967 p 139–148
(Contract NASW-1695)
(NASA-TT-F-11749) CSCL 20K

The problems of the structural and dimensional synthesis of the kinematic systems of the type of landing gear actuated by pneumatic or hydraulic cylinders, each main leg of which is composed of two parts connected by a revolute kinematic pair, are discussed. The treatment is limited to mechanisms having one driving system, or one degree of mobility. The partition method is used for structural synthesis. The retracting mechanisms are synthesized dimensionally for the extended and retracted positions of the gear. The mathematical formulas and equations used for the synthesis of the articulated leg of the landing gear for the extended and retracted positions are given. Calculations were made on the BESM-2 computer. The block diagram of the program used is included. Author

N68-31308# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STABILITY OF THIN CLOSED CYLINDRICAL SHELLS MADE FROM FIBERGLAS [OB USTOYCHIVOSTI TONIKIKH ZAMKNUTYKH TSILINDRICHESKIKH OBOLOCHEK]
V. V. Ivanov 27 Jul. 1967 14 p Transl. into ENGLISH from Stroit. Mekhan. i Raschet Sooruzhenii (USSR), no. 3, 1965 p 28–31
(FTD-HT-67-387; AD-671136)

The paper deals with the behavior of thin orthotrophic shells, made of fiberglass by the winding method, under axial compression, neglecting the time factor. The problem of the stability of an elastic closed cylindrical shell is treated in the linear formulation. The formulas obtained are checked by experiments made on circular cylindrical shells having different fiberglas structures. The cylinders are found to fail by forming bulges or depressions. A formula is given for the critical stress in axial compression of thin orthotropic fiberglas shells in which the error does not exceed plus or minus 10% for R/h = 50--150. Author (TAB)

N68-31397# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
APPROXIMATE ELASTICITY SOLUTION FOR ORTHOTROPIC CYLINDER UNDER HYDROSTATIC PRESSURE AND BAND LOADS
Andrew P. Misovec and Joseph Kempner May 1968 59 p refs
(Contract Nonr-839(39))
(PIBAL-68-11; AD-670518)

An approximate solution to the Navier equations of the three-dimensional theory of elasticity for an axisymmetric orthotropic circular cylinder subjected to internal and external pressure, axial loads, and closely spaced periodic radial loads is introduced. Numerical comparison with the exact solution for a transversely isotropic cylinder subjected to periodic band loads shows that very good accuracy is obtainable. When the results of this approximate solution are compared with previously obtained results of a Flugge-type shell solution of a ring-reinforced orthotropic cylinder, it is found that the shell theory gives a fairly accurate representation of the deformation except in the neighborhood of discontinuous loads. The addition of transverse shear deformations does not improve the accuracy of the shell solution. When Hills orthotropic yield criterion is applied, it is found that yielding could begin rather early at the inner surface of the shell adjacent to the frame. It is noted that the transverse shearing stress has no great effect on the initial yield pressure. Author (TAB)

N68-31427# General Dynamics/Convair, San Diego, Calif.
LIGHTWEIGHT RADIATIVE HEAT SHIELD DEVELOPMENT
William E. Black Dec. 1967 150 p refs
(GDC-ERR-AN-1133)

The objective of this program was to develop heat shield and insulation systems which were generally applicable to an S-5 type maneuverable re-entry vehicle and specifically suited to the Convair Variable Geometry Spacecraft (VL-3). Due to the variation in heating over the vehicle surface two systems were designed and constructed. One system was typical for the upper surface and was fabricated primarily of the superalloy Hastelloy X. The second system could be used on the vehicle's lower surface where the aerodynamic heating results in temperatures to the 2700°F range. This system was fabricated from the refractory metal columbium alloy C-129Y. The Hastelloy X version, which has a unit weight of 1.30 lb/ft^2, was subjected to six trajectory cycles with peak temperatures over 1700°F. The substructure did not exceed the designed limit of 200°F. Although some warping of the main panel did occur, the basic design was considered successful. The columbium panel employed an integrally stiffened skin with the channel stiffeners burn-down welded by electron beam. This method afforded a calculated low unit weight of 1.67 lb/ft^2. The hold-down fixture which was developed permits continuous passes of the beam while actually skip welding the channels to the skin. This technique was initially tried on 4 x 6 inch specimens. Author

N68-31446# Laval Univ. (Quebec).
SOME DEVELOPMENTS IN THE THEORY OF STABILITY, VOLUME 3
H. Ziegler 1967 18 p refs Presented at the Can. Congr. of Applied. Mech., Quebec, 22–26 May 1967
CFSTI: HC $3.00/MF $0.65

The mathematical aspects of the theory of stability are reviewed, starting with Liapunov's stability concept applied to the equilibrium configuration of a system with a finite degree of freedom. Motion, the static approach, and the effects of damping on such systems are studied, for which a classification table for mechanical systems is given. Modifications of the stability concept are examined, using the examples of elastic bodies and convergent waves. The treatment of systems by linearized differential equations is evaluated. In general, the purely mechanical problems that are analyzed concern themselves with the manner in which a given physical situation can be described in mathematical terms. K.W.

N68-31455# Pennsylvania State Univ., University Park. Ordnance Research Lab.
VIBRATION OF A VISCOELASTIC SPHERICAL SHELL IN AN INFINITE ACOUSTIC MEDIUM
H. C. Hagendorf 9 Oct. 1967 40 p refs
(Contract NOw-65-0123-d)
(TM-646.3361-04; AD-670730)

The effects of viscoelasticity on the response of a fluid filled viscoelastic spherical shell imbedded in an infinite acoustic medium are investigated. The shell is subjected to a harmonic internal pressure. Solutions are presented for the displacement field in the shell and the external and internal acoustic pressure fields. The viscoelastic materials used for numerical results were high and low damping rubbers in the frequency ranges of 10 - 3,000 cps and at 5C. Author (TAB)

N68-31545# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
THE RELATIONSHIP BETWEEN FATIGUE LIFE UNDER CONSTANT AND UNDER VARIABLE STRESS AMPLITUDES AND ITS UTILIZATION FOR THE DESIGN OF AIRCRAFT STRUCTURES [UEBER EINE BEZIEHUNG ZWISCHEN DER

LEBENSDAUER BEI KONSTANTER UND BEI VERAENDERLICHER BEANSPRUCHUNGSAMPLITUDE UND IHRE ANWENDBARKEIT AUF DIE BEMESSUNG VON FLUGZE|

W. Schuetz 1966 58 p refs In GERMAN; ENGLISH summary
(FB-69(1966); JCAF-349) CFSTI: HC $3.00/MF $0.65

The relationship between fatigue life under constant stress amplitudes and under normally distributed variable stress amplitudes is investigated for several materials and components used in aircraft and automotive construction, mainly 2024-T4 and a Cr-Mo-V-steel similar to SAE 4340. The primary parameters affecting this relation are varied systematically. The relations found allow the results of constant amplitude tests in the finite life range to be utilized in the initial design of aircraft structures. Author

N68-31562# Pennsylvania State Univ., University Park. Ordnance Research Lab.

NATURAL FREQUENCIES AND STRAIN DISTRIBUTION IN A STIFFENED, THICK CYLINDRICAL SHELL

J. S. Patel 25 Sep. 1967 137 p refs
(Contract NOw-65-0123-d)
(TM-405.3361-31; AD-670727)

The vibration amplitudes and the strain distribution at resonance in a ring-stiffened cylindrical shell were investigated theoretically and experimentally. The Love-Kirchoff assumptions were modified because it was found necessary to account for the transverse shear strains and stress and strains normal to the reference surface. The relationship between shear factor and analytical results was studied. Four displacement functions were considered, and it was concluded that the function used by Galletly is sufficiently accurate up to 3000 cycles per second for the particularly shell dimensions considered. Author (TAB)

N68-31566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRENGTH AND DESTRUCTION OF HIGHLY ELASTIC MATERIALS

G. M. Bartenev and Yu. S. Zuyev 8 Sep. 1967 364 p refs Transl. into ENGLISH of "Prochnost' I Razrusheniye Vysokoelasticheskikh Materialov" Moscow, Izd. Khim., 1964 p 1-387
(FTD-MT-66-10; AD-670814)

The book deals with the problem of the strength of elastic materials. The concept of the strength, service life, and mechanism of the failure of solids and polymers is outlined and problems of the strength of highly elastic materials, the effect of deformation conditions, composition, and structure of rubber on its strength and service life are discussed. The last five chapters deal with problems of rubber cracking and service life under the effect of chemical agents. Author (TAB)

N68-31602*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF A COMPARTMENTED-GAS-BAG LANDING SYSTEM HAVING MULTIPLE IMPACT CAPABILITIES

John R. McGehee Washington Aug. 1968 38 p refs
(NASA-TN-D-4710) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The principles of the proposed landing system were investigated experimentally to determine the kinetic energy dissipating capability of the system. A simplified test vehicle, using unidirectional gas bags, was tested with both sharp-edged and fabric covered orifices between the compartments. A supplementary experimental investigation was conducted to determine the discharge parameters associated with various fabrics. In addition, equations were derived for computing time histories of acceleration, velocity, stroke, and compartment pressures to extend the usefulness of the investigation by permitting variation of the landing environment and test vehicle parameters. The results show a kinetic energy dissipation capability for the initial impact as great as 93 percent of the vehicle touchdown kinetic energy. Tests performed with aircraft fabric covered orifices yielded a slightly greater (approximately 5 percent) kinetic energy dissipation capability than was obtained with the sharp-edged orifices. The analytical investigation resulted in a computational procedure which provides fair agreement between computed and experimentally determined accelerations, pressures, and kinetic energy dissipation for the ranges of velocity and bag initial pressures investigated. Author

N68-31626# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRENGTH OF MATERIALS

V. I. Feodos'yev 29 Aug. 1967 532 p refs Transl. into ENGLISH from "Soprotivleniye Materialov" Moscow, Gos. Izd. Fiz.-Mat. Lit. 1963 p 1-539
(FTD-MT-65-277; AD-670875)

A 520 page, 18 chapter text book on strength of materials written for use in a three-semester course on the subject as taught by the author at the N. E. Bauman Moscow Highest Technical School. This is the improved edition published in 1963. In distinction to theoretical mechanics, the subject matter confines itself to problems essential to the properties of deformable bodies, e.g., external and internal forces and stress. Author (TAB)

N68-31627# National Engineering Lab., Glasgow (Scotland).

A PHOTOELASTIC INVESTIGATION OF THE STRESS DISTRIBUTION IN UNIAXIALLY LOADED THICK PLATES CONTAINING SLITS

J. R. Dixon and J. S. Strannigan May 1967 28 p refs
(NEL-288) CFSTI: HC $3.00/MF $0.65

Three-dimensional photoelastic tests were carried out on uniaxially loaded thick-plate models containing central and co-planar edge slits having various geometries through the thickness. The stress distributions show the modes of changeover from plane stress conditions on the outside surface of the plate to plane strain conditions in the interior. The results are discussed in relation to three-dimensional aspects of fatigue-crack growth, fast fracture and plastic deformation. Author

N68-31629*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ON THE BOUND OF FIRST EXCURSION PROBABILITY

J. N. Yang and M. Shinozuka 15 Aug. 1968 11 p refs
(Contract NAS7-100)
(NASA-CR-95961; JPL-TR-32-1304) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Because of its direct relation to the reliability or the safe performance of mechanical and structural systems subjected to random external disturbances the bounding technique of the first excursion probability is studied. In particular, the lower bound of the probability proposed previously by one of the present authors is imporved. Numerical examples indicate that the improvement is significant. The present method of improvement requires the knowledge of the joint density function of the random process at two arbitraty instants. Other than this, the method is universal; it can apply to stationary or nonstationary, Gaussian or non-Gaussian processes. General expressions for lower and upper bounds are also derived in this study and their potential usefulness is pointed out. Author

N68-31650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DERIVATION OF GRID EQUATIONS OF PLATE BENDING BY THE VARIATIONAL METHOD [VYVOD SETOCHNYKH URAVNENIY IZGIBA PLASTIN VARIATSIONNYM METODOM]

D. V. Vaynberg, V. M. Gerashchenko, I. Z. Roytfarb, and A. L. Sinyavskiy 14 Sep. 1967 17 p refs Transl. into ENGLISH from Soprotivleniye Materialov i Teoriya Sooruzheniy (Kiev), no. 1, 1965 p 23–33
(FTD-HT-67-336; AD-670908)

A method of applying network equations for plate deflection problems is developed. A thin plate, such as that shown in Fig. 1, is considered. The ensuing quadratic network is used for substituting summation by the rectangular formula into the integral terms of the given energy expression. Differential substitutions are accomplished by computation of central differences. The authors develop and illustrate the mechanics of defining and evaluating the summation terms. The method presented was applied to the formulation of systems of difference equations for plates of variable stiffness, anisotropic plates, contact problems, and shells. The results of the applications are to be published in subsequent articles. TAB

N68-31679# United Kingdom Atomic Energy Authority, Risley (England).

AN APPROXIMATE METHOD OF CALCULATING PLANE STRAIN FRACTURE TOUGHNESS (K_{IC}) FOR NOTCHED SPECIMENS

L. Lazzeri (Pisa Univ.) and G. W. Parry (Reactor Mater. Lab., Culcheth) 1968 10 p refs Presented at a Conf. on High-Strength Materials, Sheffield Univ., 27–29 Mar. 1968
(TRG-1665(C)) CFSTI: HC $3.00/MF $0.65

The Griffith-Irwin equation expresses the stress intensity or fracture toughness parameter for an infinite plate containing a crack in terms of crack length and applied stress. By applying boundary conditions to the equation, an expression has been derived which provides a simple method of approximating the plane strain fracture toughness (K_{IC}) for notched specimens from a knowledge of notch depth, specimen width and applied stress. The equation avoids some of the complexities inherent in the previously recommended A.S.T.M. practice for calculation of K_{IC} since it eliminates the use of the polynomial expressions involving notch depth/specimen width ratio which vary with specimen configuration. Recent improvements in the A.S.T.M. calculations have greatly simplified the procedure; however, the proposed equation provides an alternative method, and comparison of K_{IC} values obtained from both methods shows agreement to within a few per cent. The derivation and use of the equation is described. Limits of accuracy required for K_{IC} determinations are discussed relative to their practical application in assessing critical defect sizes in components and the ability to detect such defects by inspection. Author

N68-31709

CORRELATION THEORY OF SUBCRITICAL DEFORMATIONS OF THIN ELASTIC SHELLS

V. V. Bolotin and B. P. Makarov [1968] 9 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 3, 1968 p 428–434
CFSTI: HC $3.00/MF $0.65

Equations obtained by linearizing the shell theory equation in the neighborhood of the initial stress state are presented as a solution to the stochastic boundary value problem. An additional assumption is made on the smallness of the scale of the initial deviations and of the scale of their correlation as compared to the characteristic dimensions of the middle surface; the homogeneity of the field of initial deviations is also assumed. General formulas are deduced for the correlation functions, the variance, and the spectral densities of the parameters of the shell's stress–strain state. Results are expressed in terms of tabulated functions for a broad class of isotropic initial deviations. This permits a study of the dependence of the correlation properties of the displacements, deformations, and stresses on the properties of the initial deviations and on the initial stresses in the middle surface. Author

N68-31711

NONRIGIDITY OF A NON-SHALLOW SPHERICAL DOME

L. S. Srubshchik [1968] 13 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 32, no. 3, 1968 p 435–444
CFSTI: HC $3.00/MF $0.65

A system of nonlinear Reisner differential equations is formulated for the symmetric deformation of a spherical dome free of the effect of loading with boundary conditions corresponding to a fixed hinge clamping the dome along the edge. All quantities expressed are dimensionless. These equations contain a natural small parameter ϵ^2, which characterizes the relative thinness of the shell wall. To prove the existence of a second solution, asymptotic expansions are first constructed for small ϵ^2, and then the existence of the second solution is proved for the problem for which the constructed asymptotic expansions are valid. It is noted that if the formal construction of the asymptotic goes through for any spherical segments (including large hemispheres), then the proposed method for the existence of the second solution is connected to the constraint that the domes be less than a hemisphere. Author

N68-31712

NONLINEAR PROBLEMS FOR A SPHERICAL SHELL WITH A REINFORCED HOLE

I. S. Chernyshenko [1968] 4 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), v. 4, no. 5, 1968 p 133–136
CFSTI: HC $3.00/MF $0.65

Nonlinear factors are considered in determining the axisymmetric stress–strain state of a spherical shell weakened by a circular hole. The shell is subjected to internal pressure resulting in an elastoplastic state, and receives deflections comparable to its thickness. The theories of small elastoplastic strains and of medium bending shells are used; the nonlinear differential equations in displacements are integrated by successive approximations in combination with finite differences. Results of solutions for several ring stiffness versions are examined. It is noted that in the case of a ring, with nonlinearities in the shell considered, no plastic deformations originate. The consideration of nonlinearities for both low and high ring stiffness results in a stress redistribution and equilibration of their values over the shell thickness as compared with the elastic problem. It was also found that taking account of the ring displacement magnifies the stress intensity on both surfaces for low stiffnesses in both the linear (by 20% to 30%) and the nonlinear (by 5% to 21%) formulations, and redistributes the stresses for stiffnesses larger or closer to the optimum. M.G.J.

N68-31714

STABILITY OF RECTANGULAR SANDWICH PLATES UNDER COMPLEX BOUNDARY CONDITIONS

G. I. Kharkhun [1968] 9 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 20, no. 3, May–Jun. 1968 p 418–426
CFSTI: HC $3.00/MF $0.65

The method of summary representations is used to investigate the stability of sandwich plates, as results obtained by the method of meshes show that a simple increase in the quantity of internal nodes of the mesh domain, without involving any analytical methods of determining the finite difference equations, do not lead to accurate and reliable solutions. The static stability equation is derived in a form to represent the finite differences. To investigate the natural vibrations of sandwich plates, the Fourier finite difference method is introduced. Several examples are given to show the effect of different boundary conditions. It is concluded that the problem of seeking the zeros of the characteristic determinant of the finite difference system of equations under rigid fixing boundary conditions reduces to finding the zeros of four determinants of comparatively low order. M.G.J.

N68-31715

GENERAL SOLUTIONS OF THREE-DIMENSIONAL LINEARIZED STABILITY EQUATIONS OF ELASTOPLASTIC SOLIDS

A. N. Guz [1968] 4 p refs Transl. into ENGLISH From Dopovidi Akad. Nauk Uk. RSR, Ser. Fiz. Tekhn. i Mat. Nauk (USSR), no. 4, 1968 p 322–325
CFSTI: HC$3.00/MF$0.65

General solutions are presented for small elastoplastic deformations, based on three-dimensional linearized stability equations of elastic bodies. Consideration is given to a three-dimensional body axially compressed along ox_3 by forces of intensity p. The precritical deformation is considered to be small. An operator method is used to construct the general solution of the system, with the solution represented as one of three modes or as their linear combinations. Author

N68-31716# Los Alamos Scientific Lab., N. Mex.
CRITICAL DIMENSIONS OF HOMOGENEOUS SPHERES CONTAINING U 235, U 238, AND CARBON FOR VARIOUS C/U 235 RATIOS AND U 235 ENRICHMENTS
L. B. Engle and W. R. Stratton 15 May 1968 13 p refs
(Contract W-7405-eng-36)
(LA-3883-MS) CFSTI: HC$3.00/MF$0.65

The critical dimensions of homogeneous spheres containing ^{235}U, ^{238}U, and carbon at various C/^{235}U moderating ratios and ^{235}U enrichments are presented. Some values of K_∞ for these mixtures are included. Author (NSA)

N68-31720
STABILITY OF CIRCULAR CYLINDRICAL SHELLS UNDER A BENDING FORCE
V. V. Kabanov and V. S. Uteshev [1968] 7 p refs Transl. into ENGLISH from Inzh. Zh. Mekhn. Tverd. Tela (USSR), no. 2, 1968 p 65–69
CFSTI: HC$3.00/MF$0.65

Consideration is given to the problem of stability in a clamped thin elastic circular cylindrical shell subjected to bending by a transverse force applied to a stiff ring reinforcing the free edge. The deflection is approximated by a double trigonometric series, using the Bubnov–Galerkin method. An electronic computer is used for the solution with the critical forces and buckling modes calculated from 48-th order matrices. The elements of these matrices are determined by the 48 principal terms of the series which were chosen out of the first 400 terms. The theoretical solution is compared with experimental data, and the theory yields a 10% to 25% exaggeration in the critical loadings indicating the applicability of a linear solution. Theoretical buckling modes are in satisfactory agreement with the experimental values. A comparison is also drawn between the theoretical solution and experiments with the approximate estimate of shell stability, based on replacement of the inhomogeneous stress state by a homogeneous state and the use of known solutions. Author

N68-31739# Lockheed Missiles and Space Co., Palo Alto, Calif.
SNAPPING OF A CYLINDRICAL PANEL SUBJECTED TO AN ACOUSTIC PRESSURE SHOCKWAVE
E. I. Grigolyuk, A. G. Gorshkov, and F. N. Shklyarchuk [1967] 8 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), no. 5, 1967 p 50–55
(PB-177581T) CFSTI: HC$3.00/MF$0.65

The behavior of a thin elastic circular cylindrical hinge-supported panel, fixed in a rigid cylindrical screen and subjected to an acoustic shock whose front is parallel to the panel generatrix is studied. The transverse panel motions are described by the known equations of finite deflection from thin shallow shell theory. Two kinds of approximations were made in the analytical solution, an approximation to the shape of the moving panel, and an approximation of the pressure from the acoustic wave field. Author (USGRDR)

N68-31742# Illinois Univ., Urbana.
STRESS CONCENTRATION AT EXTERNAL NOTCHES IN MEMBERS SUBJECTED TO AXIAL LOADING
A. T. Derecho and W. H. Munse [1967] 64 p refs Sponsored by State of Ill. Dept. of Highways and Bur. of Public Roads, Washington, D. C. *Its* Eng. Expt. Station Bull. 494
(PB-178127) CFSTI: HC$3.00/MF$0.65

The principal object of the study reported here was to analyze the effects of the various parameters that define the external geometry of projecting notches on the associated stress concentration factor. The study deals particularly with notches occurring symmetrically in rectangular bars subjected to axial loading. USGRDR

N68-31766
STABILITY OF A CYLINDRICAL SHELL SUBJECTED TO EXTERNAL PRESSURE VARYING ALONG THE LENGTH AND TAKING ACCOUNT OF THE INITIAL BENDING STATE
G. E. Mikaelian [1968] 7 p refs Transl. into ENGLISH from Izv. an Armssr, Mekhn. (USSR), v. 20, no. 6, 1967 p 30–37
CFSTI: HC$3.00/MF$0.65

The stability of the bending stress state of an elastic shallow circular cylindrical shell is considered, and the influence of the deformation of the unperturbed state on the magnitude of the critical loading is investigated. The cases of a single-layer isotropic shell and multilayer orthotropic shell are examined. Author

N68-31788# North Carolina State Coll., Raleigh. Applied Mathematics Research Group.
A NONLINEAR INTEGRO-DIFFERENTIAL EQUATION ASSOCIATED WITH A CLASS OF WEDGE PROBLEMS
George Marvin Eargle May 1968 83 p refs
(Grant AF-AFOSR-444-66)
(AFOSR-68-1373; AD-671168)

The Mellin integral transform is used to investigate the displacement near the vertex of an infinite, isotropic, elastic wedge in a state of plane stress under mixed boundary conditions. Normal stresses are prescribed near the vertex and normal displacements are assumed to be zero elsewhere along the boundary. A nonlinear integro-differential equation is derived in which the unknown function is related to the desired displacement. This and a related nonlinear algebraic system are analyzed. Methods are developed to compute the solution for the special case of the wedge of vertex angle pi. These methods are extended to a more general wedge and an example of the more general computation is given. Author (TAB)

N68-31789# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
AN ITERATIVE METHOD FOR THE ANALYSIS OF LARGE STRUCTURAL SYSTEMS
V. B. Venkayya Apr. 1968 51 p refs
(AFFDL-TR-67-194; AD-670846)

An iterative method to analyze large structural systems subjected to static and thermal loadings is developed. This method is essentially the displacement method of analysis in which the finite elements are grouped into convenient size substructures. The analysis proceeds with one substructure at a time, and a process of iteration establishes the continuity of the system. The speed of convergence depends on the nature of the stiffness matrices of the substructures. To illustrate the method, two frame structures are analyzed. One is an 1800 degree of freedom system and the other a smaller system. The purpose of the larger one is to estimate the computational time involved. The results of the smaller system (by iterative analysis) are compared with those obtained from direct analysis, and the results are nearly the same. The main advantages of the iteration method are that the entire computational scheme can be carried out without exceeding the core capacity of the computer, and the method is more economical with respect to computational time than the direct analysis. Author (TAB)

N68-31799# Northwestern Univ., Evanston, Ill. Structual Mechanics Lab.
PARAMETRIC RESONANCE OF ONE-DIMENSIONAL STRUCTURES SUBJECTED TO PERIODIC IMPACTS
Dusan P. Krajcinovic and George Herrmann Feb. 1968 50 p refs
(Grant AF-AFOSR-100-67)
(TR-68-1; AFOSR-68-0753; AD-670566)

A general procedure is developed to analyze the parametric resonance of one-dimensional structures subjected to periodic impulsive loading. The procedure is applicable to systems governed by a set of simultaneous Hills equations and makes use of Fourier series and Hills determinants. The procedure is illustrated by several examples of thin-walled beams. Author (TAB)

N68-31806*# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering.
THE DIRECT POTENTIAL METHOD IN THREE DIMENSIONAL ELASTOSTATICS
T. A. Cruse Jun. 1968 32 p refs
(Grant NGR-39-002-123)
(NASA-CR-66673; SM-13) CFSTI: HC $3.00/MF $0.65 CSCL 20 K

The direct and indirect potential methods are proposed for use in analyzing problems in three dimensional elastostatics. A primary feature of the potential method for boundary and initial value problems is that solution forms may be obtained which automatically include the prescribed data, boundary configuration, and region connectivity. In the indirect procedure integral equations are written in terms of harmonic functions from which the displacements and stresses must be derived by differentiation. The necessary boundary values for these functions must be established by integration of the actual boundary conditions. In the direct method integral equations are obtained whose unknowns are the unknown surface tractions and displacements, thus eliminating the need for intermediate potential functions. Interior stresses and displacements are calculated directly from tensor and vector identities respectively. Numerical solution of the integral equations is achieved by reduction to algebraic equations to which standard computer methods are applied. D.H.B.

N68-31811# Technische Hochschule Munchen (West Germany). Institut fuer Technische Mechanik.
THEORETICAL DETERMINATION OF FATIGUE STRENGTH AT STRESS CONCENTRATION
Heinz Neuber Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1967 32 p refs
(Contract AF 61(052)-671)
(AFML-TR-68-20; AD-670857)

The mechanism of stress and strain concentration at fatigue loading is governed by two fundamental effects. Within the yield range of ductile materials the macro-support effect is dominating which in this paper is represented by the results of a non-linear theory derived by the author. Within the high-cycle fatigue range the micro-support effect is governing which can be described by the authors theory of mean stress value, originally derived in connection with the calculation of sharply curved notches. In this theory a material constant of length dimension is introduced. Taking into account these two effects an approximate precalculation of the fatigue strength of notched construction parts is possible. Author (TAB)

N68-31821# Washington Univ., Seattle. Lab. of Statistical Research.
ESTIMATION FOR A FAMILY OF LIFE DISTRIBUTIONS WITH APPLICATIONS TO FATIGUE
Z. W. Birnbaum and Sam C. Saunders (Boeing Sci. Res. Labs.) 28 May 1968 33 p refs
(Contract Nonr-477(38))
(TR-56; AD-670565)

The estimation problem is studied for a new two-parameter family of life length distributions which has been previously derived from a model of fatigue crack growth. Maximum likelihood estimates of both parameters are obtained and iterative computing procedures are given and examined. A simple estimate of the median life is exhibited, shown to be consistent and then compared, favorably, with the maximum likelihood estimate. More importantly, the asymptotic distribution of this estimate is shown to be within the same class of distributions as the observations themselves. This model and these estimation procedures are tried by fitting this distribution to several extensive sets of fatigue data and then some comparisons of practical significance are made. Author (TAB)

N68-31838# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
TESTS OF BOLTED BUTT SPLICES
John W. Fisher and Geoffrey L. Kulak Dec. 1967 27 p refs
(FEL-317-11; PB-177699)

The results of experimental studies of constructional alloy (A514) steel butt splice fastened by A490 bolts are reported. Also included are results of experimental work on hybrid joints. This includes A36–A440 steel joints and A440–A514 steel joints fastened by A325 bolts as well as an A440–A514 steel joint fastened by A490 bolts. The joint tests are compared with predicted results. It is shown that the previously developed theoretical work and analytical studies are verified. Good agreement is obtained for ultimate strength and the distribution of load among the fasteners. The study has also shown that the slip coefficient of grit blasted steel faying surfaces is about 0.34. The use of higher allowable shear stresses for A325 and A490 bolts in bearing-type connectors is found appropriate for both types of joints. USGRDR

N68-31846*# Louisiana State Univ., Baton Rouge.
A PHOTOELASTIC DETERMINATION ON THE NORMAL STRESS UNDER BOLT HEADS
G. D. Whitehouse and D. J. Bilyeu [1968] 26 p refs
(Grant NGR-19-110-024)
(NASA-CR-96157) CFSTI: HC $3.00/MF $0.65 CSCL 20 K

An experimental investigation using photoelastic techniques has been used to provide information concerning the actual stress distribution between fasteners and plates. The techniques of stress freezing and model slicing were used on a number of specimens constructed from Hysol CP 54290. The curves representing the stress distributions and magnitudes are plotted for fillister head and button head bolts. Previous investigations using analytical methods for calculating stress distributions for fillister head bolts are compared to the results obtained photoelastically. Previous experimental stress distributions obtained by oil pressure and penetration techniques are compared to stresses determined photoelastically for the button head bolt. It was confirmed from the results that age-old assumption of uniform normal stresses under the bolt heads is invalid. The shape of the bolt head greatly influences the stress distribution. A stress distribution of an exponential form generally exists for constant shank load. Author

N68-31912*# General Electric Co., King of Prussia, Pa.
PLATE-GAP MODEL OF A POROUS SOLID AND ITS APPLICATION TO IMPACT BY REDUCED DENSITY PROJECTILES
J. F. Heyda Washington NASA Aug. 1968 39 p refs
(Contract NAS3-8512)
(NASA-CR-1140 CFSTI: HC $3.00/MF $0.65 CSCL 20K

The sensitivity of the peak axial profiles, obtained using the impact model of an earlier report, to a change in the Hugoniot function assumed for the reduced density projectiles is examined briefly. The previous Hugoniot function, based on the Los Alamos equation of state for aluminum, is replaced by one based on the Plate-Gap model of a porous solid due to Thousenin. A modification of this model is described in detail and its comparison with existing

experimental data for six porous materials and the predictions of the theoretically based equation of state due to Wagner and Bjork for aluminum is noted. Comparison is also made of calculated peak axial pressures obtained using the impact model for the case of normal density aluminum projectiles impacting aluminum with experimental data obtained from corresponding jet projector impact shots. Author

N68-31946*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PLASTIC BUCKLING OF PLATES AND SHELLS UNDER BIAXIAL LOADING
James P. Peterson Washington Aug. 1968 32 p refs
(NASA-TN-D-4706) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Available elastic buckling equations are used in making the plastic buckling calculation by substituting wall stiffnesses derived from a plastic buckling theory for the elastic orthotropic wall stiffnesses associated with the elastic buckling equations. This method permits the calculation of the buckling load of many structures of current interest which cannot be handled by available methods. Buckling loads of cylinders and plates of conventional, sandwich, and laminated construction are easily calculated. The cylinders and plates may have stiffening members which may be eccentric (one-sided) and which may be made of a different material than the skin. For many structures, the effect of transverse shear can be taken into account in the buckling calculations. Author

N68-31982*# Institute of Modern Languages, Inc., Washington, D. C.
EXPERIMENTAL STUDIES OF THE THEORY OF W. RITZ ON TRANSVERSE VIBRATIONS OF SQUARE PLATES [EXPERIMENTELLE UNTERSUCHUNGEN ZUR W. RITZCHEN THEORIE DER TRANSVERSALSCHWINGUNGEN QUADRATISCHER PLATTEN]
Alice Lemke NASA Jul. 1968 35 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 86, 1928 p 717–750
(Contract NASw-1693)
(NASA-TT-F-11576) CFSTI: HC$3.00/MF$0.65 CSLC 20K

Transverse vibrations of plane elastic plates have been studied. Experimental data are correlated to theoretical requirements. The accuracy of most of the measurements is not very great. Extensive tables have been compiled and are considered to be of general significance. Author

N68-32032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESS FUNCTIONS IN SHELL THEORY [K VOPROSY O FUNKTSIYAKH NAPRYAZHENIY V TEORII OBOLOCHEK]
M. P. Sheremet'yev 7 Aug. 1967 8 p refs Transl. into ENGLISH from Tr. Vses. Konf. po Teoriya Plastin i Obolochek (USSR), 1962 p 109–110
(FTD-HT-23-783-67; AD-670059)

The author proposes a theorem based on the equilibrium formula of A. I. Lurye and A. L. Goldenveyzer and the conditions defining the necessary and sufficient condition for fulfillment of the static equilibrium conditions composed for any finite part of a shell. Proceeding from this theorem the author then develops formulas for constructing the stress functions. Author (TAB)

N68-32051*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE THRE-DIMENSIONAL VIBRATION CHARACTERISTICS OF A SCALED MODEL OF AN ASYMMETRICAL LAUNCH VEHICLE
Ellwood L. Peele, William M. Thompson, Jr., and Christine G. Pusey Washington Aug. 1968 56 p refs
(NASA-TN-D-4707) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The three-dimensional vibration characteristics of a dynamically scaled model of an asymmetrically clustered launch vehicle were investigated both analytically and experimentally. The matrix Holzer analysis formulated specifically for this model configuration is identified as being three-dimensional because it renders possible the analysis of motion which is coupled in three planes: lateral bending motion in two planes (pitch and yaw), torsional motion, and longitudinal motion. Previous two-dimensional analyses of similar configurations considered pitch-torsion uncoupled from yaw-longitudinal motion. The suitability of the analysis is evaluated by comparison of computed vibration characteristics with measured response of a near-replica scaled model to lateral excitation. On the basis of these comparisons, the procedure was found to be capable of predicting the major vibration characteristics. Additional comparison is made between computed data based on a coupled and uncoupled mathematical model. These comparisons indicate that for this configuration, the coupled and uncoupled analysis yielded essentially the same results. Author

N68-32071*# General Electric Co., Daytona Beach, Fla. Missile and Space Div.
APPLICATION OF FIBROUS COMPOSITE MATERIALS TO LARGE ROCKET SYSTEMS
B. Walter Rosen, Roger Snyder, and N. F. Dow Oct. 1967 52 p refs
(Contract NAS2-3811)
(NASA-CR-73235; R67SD57) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Studies of the potential for minimization of structural weight in large launch vehicles of the future through the use of composite materials are described. Previous structural weight minimization techniques for composites are reviewed and extended. Typical structural efficiency charts are presented. Significant weight saving through the application of an efficiently stiffened composite structure is demonstrated. Author

N68-32074*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PREDICTION OF FATIGUE-CRACK-PROPAGATION BEHAVIOR IN PANELS WITH SIMULATED RIVET FORCES
I. E. Figge and J. C. Newman, Jr. Washington Aug. 1968 33 p refs
(NASA-TN-D-4702) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Analytical and experimental studies were conducted to determine the rates of fatigue crack propagation in 7075-T6 aluminum alloy sheet specimens containing either symmetric or nonsymmetric cracks subjected to uniform end loads, concentrated loads, or combinations of both. The concentrated loads simulated rivet forces and were applied by a special hydraulic fixture which is described. These studies indicate that the curve of stress-intensity factor against crack growth rate obtained from tests on simple specimens of a given material tested at load ratios of 0.05 to −1 can be successfully used to predict the crack propagation behavior of complex specimens of the same material tested over the same range of load ratios. It was also observed that better predictions of life were obtained for panels subjected to concentrated forces when the stress intensity factors were obtained by using the measured strains on the uncracked panels rather than by using those obtained from the theoretical point load solutions. Author

N68-32081# Case Inst. of Tech., Cleveland, Ohio.
PRESSURE DERIVATIVE OF THE LONGITUDINAL WAVE OF IRON
Kenneth F. Loje May 1968 16 p refs
(Contract Nonr-1141(05))
(TR-12; AD-670521)

Backing up an acoustic sample with a solid material is to be avoided as this has a definite effect on the longitudinal waves. The hysteresis found in iron is real and the cause at present

is unknown. The peculiar effect of two linear portions in transit time versus pressure has only been observed in the C prime sub 11 longitudinal wave in iron. Author (TAB)

N68-32127*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
EXPERIMENTAL STUDY OF SOUND AND VIBRATION TRANSMISSION TO A SHROUD-ENCLOSED SPACECRAFT
Annual Report, 20 Jan. 1967–20 Jan. 1968
Jerome E. Manning and Nicholas Koronaios 1 Aug. 1968 101 p refs
(Contract NAS5-10302)
(NASA-CR-96144; BBN-1592) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An experimental study of the vibration transmission in a 1/2-scale-model spacecraft-shroud assembly is described. The role of acoustic and mechanical vibration-transmission paths is studied. The individual elements of the assembly are studied as well as the complete assembly in order to better understand the vibration-transmission mechanisms. Data obtained in the program are compared with predictions obtained by using statistical energy analysis. An Appendix describes vibration measurements made on an actual OGO-Nimbus shroud. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-30884 Rice Univ., Houston, Tex.
STEADY-STATE THERMAL DESIGN OF SPACE RADIATORS
Louis Lopez (Ph.D. Thesis) 1967 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-13100

The differential equation describing a one-dimensional radiating fin having constant material properties and constant incident heat flux is solved in terms of infinite series. Neglecting longitudinal heat conduction, but considering temperature variations along the base, two computer programs are developed which are directed at design calculations. Rather than calculate the heat rejected by a given radiator (performance calculations), these programs calculate the radiator length which is required to reject a given amount of heat (design calculations). These programs are valid for radiators which have an adiabatic fin mid-point. The results from these programs are compared with performance solutions obtained using an explicit method of finite difference solution which considers two-dimensional conduction in the fin. The results of the design program are found to have an accuracy well within the range required for radiator design. Based on the results from the computer programs, an assumption is made which relates the fin base temperatures to the fin adiabatic mid-point temperature. Using this assumption, analytic solutions are obtained which give, directly, the radiator length required to reject a given amount of heat. These solutions can be extended to radiators in which adiabatic mid-points do not exist. Annotated Fortran program listings are included for the design programs and for the series solutions of the differential equations describing the fin. Dissert. Abstr.

N68-30930 Rice Univ., Houston, Tex.
A CONTINUUM THEORY OF HEAT CONDUCTING FLUID SOLID MIXTURES WITH APPLICATIONS TO TRANSIENT WAVE PROPAGATION
Anthony Bedford (Ph.D. Thesis) 1967 102 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-13053

The theory of a porous solid saturated by a mixture of n fluids can be obtained from continuum mechanics through the concept of super-imposed continua; each constituent is treated as a continuum such that any spatial point may be occupied simultaneously by a material particle of every constituent. Each constituent is assumed to have its own velocity, density, internal energy and entropy. The laws and postulates of mechanics and thermodynamics derived for n super-imposed continua resemble the equations for a single continuum except that they are summed over all constituents. The thermodynamic restrictions can be obtained by determining the circumstances under which a generalization of the Clausius-Duhem inequality can be satisfied for arbitrary values of the independent variables. The equations obtained prove that the equilibrium stresses are a function of the state of deformation of every constituent. Three boundary-value problems in a fluid saturated porous medium are solved; lateral and normal excitation of a half-space and spherical propagation from a point source. Using Laplace transforms in the time and spatial variables, solutions are obtained for impulsive excitation based on a first-order perturbation in the dissipation parameter. Dissert. Abstr.

N68-30943 Missouri Univ., Rolla.
AN INVESTIGATION OF THE INDUCTION HEATING CHARACTERISTICS OF POWDERED SUSCEPTORS DISPERSED IN A NON-CONDUCTING MEDIUM
Robert Leon Wright (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-12017

This investigation determined some of the induction heating characteristics of powdered magnetite, iron and ferrosilicon susceptor dispersed in silica sand which had been coated with thermosetting resin. The powdered susceptor particles in the mixture were heated by the field of an induction coil, consequently heating the resin coated sand and bonding the sand grains together. It was found that the type, relative amount, and particle size of the susceptor were important variables to be considered in the induction heating characteristics. Hysteresis losses in the susceptor particles, which are a function of the coil current, frequency, and permeability, appear to be the primary cause of heating. In addition, the effect of the susceptor particles on the strength of resin bonded sand was determined. The decrease in strength was found to be dependent on the number and size of the susceptor particles. Dissert. Abstr.

N68-30968 Rutgers Univ., New Brunswick, N. J.
THE THERMAL CONDUCTIVITY OF NEUTRON IRRADIATED ALUMINUM OXIDE, BERYLLIUM OXIDE, AND MAGNESIUM OXIDE AT LOW TEMPERATURES
Raymond Edward Jaeger (Ph.D. Thesis) 1967 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-14722

High density, high purity, polycrystalline specimens of alumina, beryllia, and magnesia were exposed in a reactor to integrated flux levels ranging from 5×10^{18} to 1×10^{20} n/cm^2 (energy > .01 Mev). Thermal conductivity characteristics of the rod shaped samples were determined before and after irradiation in a coil designed to measure conductivity by axial heat flow in the temperature range 30°–300°K. A phenomenological model for low temperature lattice conductivity has been used to describe both the temperature and frequency dependence of the defect scattering thus identifying the dominant mechanism responsible for phonon scattering in a given material. Between 95 and 100 percent of the damage induced by the reactor irradiation in alumina, beryllia, and magnesia is recoverable by annealing in the range from room temperature to 1100°C. Dissert. Abstr.

N68-31014 State Univ. of Iowa, Iowa City.
HEAT TRANSFER AND BOUNDARY-LAYER TRANSITION IN SHOCK-TUBE FLOWS WITH SHOCK-INDUCED EXOTHERMIC REACTIONS
Jerry Lee Hall (Ph.D. Thesis) 1967 232 p
Available from Univ. Microfilms: HC $10.60/MF $3.00 Order No. 67-12962

This investigation was an experimental study of the effect of free-stream thermal-energy release, as obtained from shock-wave induced exothermic reactions, on boundary-layer transition in shock-tube flows. The flow model was that of a boundary layer developing behind a moving shock wave in two-dimensional unsteady flow over a flat surface. Boundary-layer transition times and heat-transfer rates at transition were then read from smoothed plots of heat-flux history. Matched sets of combustible hydrogen-oxygen-nitrogen mixtures and inert hydrogen-nitrogen mixtures were used to obtain this transition data. Correlation data was approached from a combination of dimensional analysis and regression analysis. The results indicate that an appropriate combination of Stanton number, Reynolds number and a measure of shock-wave strength (such as shock-wave Mach number) should combine to correlate the transition data. The boundary-layer thickness rather than the distance from the shock wave to the transition point was found to be the important characteristic length required for data correlation. Dissert. Abstr.

N68-31036 Lehigh Univ., Bethlehem, Pa.
EFFECT OF PRESSURE ON THE CONSTANT PRESSURE HEAT CAPACITIES OF THE NITROGEN-TRIFLUOROMETHANE SYSTEM
Stephen Michael Balaban (Ph.D. Thesis) 1967 191 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-14928

The heat exchange method for determining heat capacity ratios was used in a recirculating system. Measurements were taken on nitrogen in the temperature range from −20°C to 60° at pressures up to 2000 psia, and on trifluoromethane from 22°C to 60° at pressures up to a pressure giving a density which is 10% greater than the critical density. Measurements were also obtained on two mixtures of nitrogen and trifluoromethane. The nitrogen experimental data were compared with that calculated by the virial, Bloomer-Rao, and Martin-Hou equations of state using the zero pressure heat capacities calculated by Goff and Gratch. Mixing rules for the Martin-Hou equation were suggested to fit the data that was obtained on the two nitrogen-trifluoromethane mixtures. Dissert. Abstr.

N68-31093*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMODYNAMIC APPROACH TO THE EQUATION OF STATE OF A MAGNETIZED FERMI GAS
V. Canuto, H. Y. Chiu, and L. Fassio-Canuto (Centro de Investigacion y de Estudios Avanzados) [1968] 17p refs
(NASA-TM-X-61034) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The equations of state for a magnetized Fermi gas were derived by generalizing the physical definition of the pressure. We have also given a simplified derivation of the energy eigenvalues of a free electron in a magnetic field, based on the use of simple harmonic oscillators. Physical interpretations of our results are also presented. Author

N68-31212 California Univ., Berkeley.
THERMAL RADIATION OF SOLIDS AT LIQUID HELIUM TEMPERATURES
Ernest George Cravalho (Ph.D. Thesis) 1967 168 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-11608

A number of phenomena which influence energy transfer by thermal radiation between solids at liquid helium temperatures (0°K to 5.2°K) are briefly described. These phenomena, which include wave interference, radiation tunneling, the anomalous skin effect, and the non-equilibrium radiation field effect, influence the radiative transfer to the extent that the classical laws of Stefan and Boltzmann; Hagen and Rubens; and Kirschoff are invalid. The special case of radiative transfer between two solid dielectrics separated by a vacuum gap is treated in detail. Because the electrons remain tightly bound to their parent atoms in this situation, only the coupled phenomena of wave interference and radiation tunneling are obtained. Wave interference is the result of constructive or destructive interaction of the electromagnetic waves which after being emitted by one solid experience multiple reflections in the vacuum gap. Radiation tunneling is energy transfer by means of electromagnetic waves which in the case of a single interface would be totally reflected within the solid, but because of the presence of a second interface, escape from the emitting solid. Dissert. Abstr.

N68-31346# National Standard Reference Data System.
THERMAL CONDUCTIVITY OF SELECTED MATERIALS. PART 2
C. Y. Ho, R. W. Powell, and P. E. Liley Feb. 1968 156 p refs Prepared in cooperation with Purdue Univ.
(NSRDS-NBS-16, PT. 2) CFSTI: HC $3.00/MF $0.65

The work comprises the critical evaluation, analysis, and synthesis of the available thermal conductivity data and the generation of recommended values for twelve metallic elements, mainly for the solid state, for a range of graphics, and for three fluids in the gaseous state. These are cadmium, chromium, lead, magnesium, molybdenum, nickel, niobium, tantalum, tin, titanium, zinc, zirconium, Acheson graphite, ATJ graphite, pyrolytic graphite, 875S graphite, 890S graphite, acetone, ammonia, and methane. For each of the materials recommended values are given over a wide range of temperature. Author (USDRDR)

N68-31368# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
THERMAL REGULATION FOR WALLS OF SAGEM E.27 INERTIAL CONTROL CABINET [REGULATION THERMIQUE POUR PAROI DE CENTRALE SAGEM E.27]
27 Nov. 1967 38 p In FRENCH
(LRBA-E.430-01/LI) CFSTI: HC $3.00/MF $0.65

This paper describes an on/off system for regulating the temperature of the walls of an E.27 inertial control cabinet. The active element is a cool-air inlet valve for cooling the system circuits. The valve is controlled by means of an electromagnet. The detector element is a negative temperature-coefficient resistance, the variations in the ohmic resistance of this element being picked up by an electronic system which enables the electromagnetic to be operated. ESRO

N68-31371*# Minnesota Univ., Minneapolis. Heat Transfer Lab.
FILM COOLING WITH INJECTION THROUGH A CIRCULAR HOLE Summary Report
R. J. Goldstein, E. R. G. Eckert, and J. W. Ramsey 14 May 1968 69 p refs
(Contract NAS3-7904)
(NASA-CR-54604; HTL-TR-82) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An experimental investigation is reported on the film cooling effectiveness with injection of air through a discrete hole into a turbulent boundary layer of air on a flat plate. The secondary air enters the mainstream through a circular tube inclined at an angle of either 35 degrees or 90 degrees to the main flow. Basic trends are found to be similar for the two injection angles, with differences occurring only at large injection rates. Although the trends are the same for the two injection angles, sizable differences are found in

the level of cooling which can be obtained. Injection at an angle of 35 degrees is found to yield higher effectiveness values than 90 degree injection. The film cooling effectiveness for both injection angles is found to be considerably different from that obtained when the secondary fluid is introduced through a continuous slot. Author

N68-31400# Rensselaer Polytechnic Inst., Troy, N. Y.
ON SURFACE TEMPERATURE TRANSIENTS OF RUBBING SOLIDS Technical Report, 1 Oct. 1966–31 Oct. 1967
F. F. Ling Wright-Patterson AFB, Ohio AF Mater. Lab. Nov. 1967 50 p refs
(Contract AF 33(615)-3378)
(AFML-TR-67-346; AD-670599)

The simple stochastic model of interface temperature transients of solids in sliding contact has been extended. An experimental investigation has been carried out which gave credence to the simple model. The model led to the observation that, statistically, the standard deviation of the interface transients may be an order of magnitude higher than the average interface temperature. It is suggested that it is the standard deviation which dictates the level of chemical activities at the interface. Author (TAB)

N68-31449# Aro, Inc., Arnold Air Force Station, Tenn.
ANODE NOZZLE EFFECTS ON THE BULK PROPERTIES OF ARC-HEATED ARGON Technical Report, Jun. 1966–Dec. 1967
R. J. Bryson Arnold Eng. Develop. Center Jun. 1968 30 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-68-106; AD-670511)

The thrust produced by a Gerdien-type d-c arc-jet using argon gas and exhausting into a low-pressure (approximately 2 mm Hg) test cell was measured and used to determine the momentum losses which occurred in the constant area anode nozzle. From these losses, a loss coefficient is defined which will yield good approximations for the gas total temperature and total pressure at the anode nozzle exit when applied to the standard constant area heat addition equations. The investigation was carried out for anode nozzles of different lengths and led to the fact that nozzle length was not a great contributor to these losses for relatively short nozzles (1.25 to 2.00 in.). Nozzle length was also found to play a very minor role in relation to the other contributing factors in determining the efficiency of the arc-heating process. The arc-jet was operated with gas flow rates of approximately 0.0034, 0.0042, and 0.005 lb/sec, electrical power input levels ranging from 2.7 to 5.8 kw, chamber pressures ranging from 6.7 to 11.7 psia, and gas inlet temperatures of approximately 530R. Author (TAB)

N68-31471# Aerospace Corp., El Segundo, Calif. Lab. Operations.
LINEARIZED RAYLEIGH PROBLEM WITH INCOMPLETE SURFACE ACCOMMODATION
Melvin Epstein Mar. 1968 43 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-20)-9; SAMSO-TR-68-206; AD-671123)

A kinetic theory treatment of the linearized Rayleigh problem was performed with the BGK model of the Boltzmann collision integral and various models of the wall boundary condition. The models allow consideration of the dependence of the character of the gas surface interaction on the velocities of the incident particles. Two classes of these models are considered. In the first, the particles reflected nonspecularly are assumed to have an isotropic velocity distribution; in the second class, the nonspecularly reflected particles are assumed to have an anisotropic velocity distribution. Analytical asymptotic solutions are obtained for the short-time (near-free-molecule flow) and long-time (near-continuum flow) behavior. The results indicate that incomplete accommodation considerably lengthens the time required for continuum flow to be established. The method of matched asymptotic expansions is used to obtain long-time solutions, which are uniformly valid in the Knudsen layer and far from the wall. It is found that the slip coefficient, which is evaluated from these solutions as a function of the parameters associated with the gas-surface interaction, may be significantly greater than the value predicted by the Maxwell model when the degree of accommodation is small. Author (TAB)

N68-31498*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL MEASUREMENTS OF THERMAL RADIATION PROPERTIES BY CYCLIC INCIDENT RADIATION
Ernie W. Spisz and John R. Jack Washington Aug. 1968 15 p refs
(NASA-TM-X-1618) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A new experimental technique is developed to determine simultaneously the total hemispherical emittance, solar absorptance, and absorptance-emittance ratio for metals at cryogenic temperatures. The method compares the temperature response of thin metal samples to a sinusoidal perturbation of an imposed radiant intensity. Emittance data are presented for aluminum, copper, and 304 stainless steel over the temperature range of 150 to 500 K. From the data, the applicability of the cyclic radiant intensity method is evaluated, and the problems associated with extending the method to temperatures below 150K are discussed. Author

N68-31508*# Dynatech Corp., Cambridge, Mass.
THE THERMAL CONDUCTIVITY OF TWO THERMAL INSULATING MATERIALS Final Report
R. P. Tye 22 Jul. 1968 10 p
(Contract NAS8-21262)
(NASA-CR-61915; Rept.-798) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An experiment was conducted to measure the thermal conductivity of two insulating materials over the approximate temperature range −150°F to 200°F in a vacuum using available equipment with a minimum of modification and to an accuracy of 15% or better. The two materials for investigation included a low density polyurethane foam and a multilayer cryogenic insulation of .25 mil aluminized Mylar with 30 mil polyurethane foam spacers. The test procedures are outlined, and the guarded hot plate technique of measuring the thermal conductivity of the materials in a vacuum is detailed. Tabulated data are presented on the results. B.S.D.

N68-31565 Texas Univ., Austin.
RADIAL MASS, ENERGY, AND MOMENTUM TRANSPORT IN NONISOTHERMAL PACKED BEDS
William Walter Schertz (Ph.D. Thesis) 1967 227 p
Available from Univ. Microfilms: HC $10.35/MF $3.00 Order No. 67-14884

The turbulent transport of mass, energy, and momentum was studied in a four inch diameter cylindrical column packed with 0.3 inch diameter stoneware spheres. Helium gas, continually injected at the center of the bed, was used as a tracer material, with air as the mainstream fluid. The concentration of tracer present, the temperature of the fluid, and the velocity of the gas were measured at several axial and radial increments. These data were numerically analyzed to obtain the radial component of the effective thermal conductivity as a function of radial position, and to obtain the radial component of the mass diffusivity coefficient as a function of radial position. Experimental conditions covered isothermal determinations at room temperature, and nonisothermal determinations in which heated air was passed through the packed column which was surrounded by a water filled cooling jacket for the establishment of a temperature gradient. Dissert. Abstr.

N68-31581# Akademiy Nauk URSR, Kiev.
THEORY OF NONEQUILIBRIUM PROCESSES IN STATISTICAL MECHANICS. 1: INTEGRAL EQUATION FOR DENSITY MATRIX [K TEORII NERAVNOVESNYKH PROTSESSOV V STATISTICHESKOI MEKHANIKE. 1: INTEGRAL'NOE URAVNENIE DLYA MATRITSY PLOTNOSTI]
S. V. Peletminskii and A. A. Yatsenko 1968 32 p refs In RUSSIAN
(ITF-68-3)

An integral equation is obtained for the density matrix in the case for which the system state, is described by a reduced set of parameters. As an appendix, the kinetic equations are considered in the case of a small density of particles as well as the kinetic equations for the functions of particle distrubution, temperature, and relative rate of two weakly interacting subsystems, respectively. Author (NSA)

N68-31671*# Arizona State Univ., Tempe. Dept. of Mechanical Engineering.
HEAT TRANSFER BETWEEN SURFACES IN CONTACT: THE EFFECT OF LOW CONDUCTANCE INTERSTITIAL MATERIALS. PART 3: COMPARISON OF THE EFFECTIVE THERMAL INSULATION FOR INTERSTITIAL MATERIALS UNDER COMPRESSIVE LOADS
P. A. Smuda and D. A. Gyorog Jun. 1968 90 p refs
(Grant NGR-03-001-033)
(NASA-CR-73244; ME-TR-033-3) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Information of thermal contact resistance is provided for thermal barriers (insulators) inserted between plane parallel metal surfaces. Among the seventeen interstitial materials studied at varying pressures and temperatures were carbon paper, mica, and screens of titanium, stainless steel, and tungsten. The experimental apparatus consisted of cylindrical metal test specimens attached to a heat source and heat sink in a near vacuum environment. It was configured to allow a load application of between 0 and 1000 psi over a range of +300° to −300°F. Thermocouples were fitted into the metal specimens. Bare junction tests were conducted and then a disc of interstitial material was positioned between the metal cylinders. Experimental values of thermal contact conductance are tabulated. Carbon paper tests demonstrated that thermal resistance for papers and other pliable fiber sheet materials is primarily a bulk material resistance. In contrast, mica demonstrates both a material thermal resistance and a surface resistance. Wire screens offer a substantial decrease in the junction heat transfer with the advantages of desirable mechanical properties. D.H.B.

N68-31674# Lockheed Missiles and Space Co., Palo Alto, Calif.
COMPUTATIONS OF A LAMINAR BOUNDARY LAYER WITH CHEMICAL REACTIONS IN THE NEIGHBORHOOD OF THE STAGNATION POINT OF A BODY OF REVOLUTION
B. V. Alekseev [1968] 24 p refs Transl. into ENGLISH from Russian
(PB-176453T) CFSTI HC $3.00/MF $0.65

A study of the process of graphite destruction in a high temperature gas flow is of importance at least because its percentage content in many heat shields is quite large. The fundamental purposes of the numerical computations made on the electronic computer were: (1) Computations of the chemically nonequilibrium boundary layer for the case of oxygen flow around graphite; (2) Comparison of existing computations in the frozen and equilibrium boundary layer with computations performed taking account of the finite rate of chemical reactions in the gas, on the surface and in the pores of the body; (3) Study of the influence of various molecule models on the mass rate of entrainment of the body material, the concentration distribution, etc.; (4) Consideration of the influence of inaccuracies in information about the pressure of the saturated carbon vapors on the quantities characterizing the destruction of the shield. All the considered cases correspond to the flow around a body which duplicates its shape upon destruction. Author (USGRDR)

N68-31710
ANALYSIS OF A CYLINDRICAL ELECTRICAL ARC TAKING ACCOUNT OF RADIANT ENERGY TRANSFER. ARC IN HYDROGEN AT 400 ATM PRESSURE
A. T. Onufriev and V. G. Sevast'ianenko [1968] 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 2, 1968 p 17–22
CFSTI: HC $3.00/MF $0.65

An approximate method is described for considering radiant energy transfer when using real gas properties, particularly the frequency-dependent absorption coefficient, under local thermal equilibrium conditions. As an example, an analysis is conducted on a wall-stabilized cylindrical electrical arc in a hydrogen atmosphere at 100 atm pressure for a 0.3, 1, and 3 cm channel radius, and for different current intensities up to a value on the order of 10^4 a. The strong influence of radiation on the volt–ampere characteristic of the arc, on the value of gas temperature, and the nature of its distribution along the arc radius are shown. It is pointed out that the role of radiant energy transfer in the energy balance of the arc increases as the pressure rises and, in turn, the role of the continuous spectrum in the radiation grows. Author

N68-31745# Aerojet-General Nucleonics, San Ramon, Calif.
THERMOPHYSICAL AND HEAT TRANSFER PROPERTIES OF ALKALI METALS
P. Y. Achener, W. V. Mackewicz, D. L. Fisher, and D. C. Camp Apr. 1968 259 p refs
(Contract AT(04-3)-368)
(AGN-8195, v. 1) CFSTI: HC $3.00/MF $0.65

A compilation of the latest available data are presented. The data were obtained by a comprehensive literature search and evaluated for selection of the best values. NSA

N68-31933# United Technology Center, Sunnyvale, Calif.
VAPOR PHASE COMBUSTION OF BERYLLIUM AND ALUMINUM Final Report, 1 Dec. 1964–30 Nov. 1967
Robert W. Hermsen Mar. 1968 67 p refs
(Contract AF 49(638)-1489)
(UTC-2183-FR; AFOSR-68-1249; AD-670529)

Experimental studies of the vapor-phase combustion of beryllium and aluminum were conducted using electrically vaporized wire as a source of high-temperature, high-pressure metal vapor. The effect of oxidizing atmospheres such as oxygen, water, and carbon dioxide in various mixtures and with inert diluents was investigated as well as the effect of total pressure from subatmospheric to 15 atm. Under all conditions, the beryllium oxide particles were produced in the form of regular hexagonal prisms, rather than spheres as in the case of aluminum oxide. The intensity of continuum and band radiation from aluminum and beryllium flames was investigated spectroscopically. The results showed that scattering of radiation by metal oxide particles had a strong effect on the spectral distribution of continuum radiation. A set of equations describing the condensation of beryllium or aluminum oxide droplets from an atmosphere containing metal vapor and oxygen was formulated and programmed for solution on a high-speed digital computer. Starting with a given mass fraction of metal vapor, condensation takes place both by nucleation of new particles and growth of all the particles in the system, until the partial pressure of metal vapor decreases to the equilibrium value. The time required for condensation and the resulting particle size distribution were calculated for different initial metal vapor concentrations and temperatures. Author (TAB)

N68-31959*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SIMPLIFIED METHOD FOR CALCULATING LAMINAR HEAT TRANSFER OVER BODIES AT AN ANGLE OF ATTACK

Fred R. De Jarnette and Ruby M. Davis Washington Aug. 1968 21 p refs

(NASA-TN-D-4720) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A simplified method is developed for calculating the ratio of the local to stagnation-point heat-transfer rate for bodies at an angle of attack with only the free-stream Mach number and the ratio of specific heats required as inputs. The viscous problem is simplified by using the axisymmetric analog for three-dimensional boundary layers (small cross flow in boundary layer) in conjunction with Lees' laminar heating rate for axisymmetric bodies. An approximate technique for determining the geometry of the inviscid surface streamline is presented. In this technique the direction of a streamline at a given point on the body is taken as the direction of the resultant of the free-stream velocity vector minus its normal component. For determining the inviscid surface properties, the modified Newtonian pressure distribution is used with isentropic flow along the surface. The heat transfer over spherically blunted cones with 15° and 30° samiapex angles at angles of attack of 0°, 10°, and 20° and a free-stream Mach number of 10.6 was computed. The values obtained agreed well with experimental data. Author

N68-32018# Institut Franco-Allemand de Recherches, St. Louis (France).

INFLUENCE OF ABLATION ON THE WAKE OF A DURALUMIN BODY: EXPANSION AND COMBUSTION [INFLUENCE DE L'ABLATION SUR LE SILLAGE D'UNE MAQUETTE EN DURALUMIN: EXPANSION ET COMBUSTION]

J. Vauvrecy 28 Apr. 1967 44 p refs In FRENCH

(ISL-T-10/67) CFSTI: HC$3.00/MF$0.65

Hypervelocity projectiles were studied in a firing tunnel at initial velocities of 5000 m/s in air or nitrogen at atmospheric or greater pressures from the point of view of ablation and wake. Measurement techniques were classical shadowgraphs, photographs using Kerr cell electrooptical filler, a camera with turning mirror, and photomultipliers. Duralumin spheres of 5 to 8 mm in diameter ablated, and the ablation products were loosened in front of the master couple to form gas and particle flow. When ablation was augmented, the dimensions of the projectile collar increased and there was less rapid expansion. The presence of drag, however, limited the study of expansion. Transl. by M.W.R.

N68-32073*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONFORMAL MAPPING FOR STEADY TWO-DIMENSIONAL SOLIDIFICATION ON A COLD SURFACE IN FLOWING LIQUID

Robert Siegel Washington Aug. 1968 22 p refs

(NASA-TN-D-4771) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Conformal mapping has been applied to determine the shape of two-dimensional solidified layers formed on a cold surface immersed in a flowing warm liquid. The frozen region is represented by a rectangle in a potential plane, and the rectangle is mapped into the physical plane to determine the frozen boundary configuration. The method is demonstrated for solidification on a cold plate of finite width that is insulated along its edges. Author

N68-32099*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TESTS OF A SINGLE TUBE-IN-SHELL WATER-BOILING HEAT EXCHANGER WITH A HELICAL-WIRE INSERT AND SEVERAL INLET FLOW-STABILIZING DEVICES

James R. Stone and Nick J. Sekas Washington Aug. 1968 60 p refs

(NASA-TN-D-4767) CFSTI: HC$3.00/MF$0.65 CSCL 13A

Experimental data were obtained on a vertical-upflow, single tube-in-shell, 0.436-in.-(1.11-cm) inside diameter by 60.5-in.-(1.54-m) long, water-boiling heat exchanger with a helical-wire insert (wire-pitch-to-inside-diameter ratio 1.90). Entrance-region plugs, inlet orifices, and a venturi-type inlet were tested at boiling-fluid flow rates from 60 to 100 lb$_m$/hr (0.0075 to 0.0125 kg/sec) and exit pressure = 17 psia (= 115 kN/m^2). Results are compared with those on a boiler with the same dimensions, but with no insert. Vapor superheat with heat-balance exit quality >1.0 was obtained. With no inlet device, with or without plugs the tendency for back-slugging instabilities was present. Orifices eliminated back-slugging, but exit quality of 1.0 was not obtained, although vapor superheat was indicated. The venturi eliminated back slugging and gave a heat-balance quality as high as 1.02; however, the flow range was limited. Author

N68-32156# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

FITS TO THERMODYNAMIC PROPERTIES OF WATER

W. B. Jordan 1 Nov. 1967 20 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6734(WBJ-5)) CFSTI: HC$3.00/MF$0.65

Algebraic fits for enthalpy, temperature and density of water are presented. The fits are designed to cover the range from 1 atm to critical pressure, and from freezing to boiling. Calculations from these fits are compared to data from the Sixth International Conference and the discrepancies are presented in graphical form. Author (NSA)

N68-32165# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.

COVARIANT STATISTICAL MECHANICS

B. Touschek 14 Jun. 1968 15 p refs

(LNF-68/31) CFSTI: HC$3.00/MF$0.65

Data on the relativistic transformation properties of thermodynamical quantities are reviewed, with attention centered on the Synge procedure of introducing a vector reciprocal temperature and arriving at a completely satisfactory description of a relativistic gas of particles with point interactions. It is pointed out that the temperature is the reciprocal of a relativistic four-vector; this four-vector is time-like and parallel to the velocity four-vector which describes the motion of the relativistic gas as a whole. Therefore, what was one parameter (the temperature) in the nonrelativistic theory becomes four parameters (the rest-frame temperature plus the three components of the velocity of relative motion) in a relativistic situation. This procedure is generalized to show the possibility of establishing a complete framework of relativistic thermodynamics as well as relativistic statistical mechanics for an equilibrium situation. M.G.J.

N68-32179# Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung E. V., Darmstadt (West Germany).

HIGH SPEED PHOTOGRAPHIC TESTS ON SPHERICAL DEFLAGRATION AND DETONATION WAVES IN GASEOUS MIXTURES [KURZZEITFOTOGRAFISCHE UNTERSUCHUNGEN AN KUGELFOERMIGEN DEFLAGRATIONS-UND DETONATIONSWELLEN IN GASGEMISCHEN]

H. Reichenbach and W. Struck [1965] 33 p refs In GERMAN

(Rept.-10/68) CFSTI: HC$3.00/MF$0.65

Streak interferograms were used to observe reaction fronts and shock wave propagation during oxygen-acetylene detonation in one dimensional flow. Results established the fundamental differences between spherical propagating deflagration and the detonation front; the latter exhibited a pronounced density shift

with three dimensional characteristics. The spherically propagating detonation waves were free from instabilities and turbulences and a real transition from deflagration to detonation was not observed. Transl. by G.G.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-31342# European Space Technology Center, Noordwijk (Netherlands).
PROJECT MANAGEMENT: A PROPOSAL TO INCREASE THE EFFECTIVENESS OF PROJECT GROUPS
J. Schatz Paris, ESRO Mar. 1968 20 p refs
(ESRO-TM-115) CFSTI: HC$3.00/MF$0.65

On the basis of experience acquired in the development of an international satellite project, a proposal is made for the efficient organisation of project management; this proposal is applicable to both future and current programs. The essential characteristic of the proposed scheme of organization is the delegation of responsibility (together with the corresponding authority) by the system manager to the subsystem management and, in turn, to system engineer level. Author (ESRO)

N68-31361# Stanford Univ., Calif. Dept. of Operations Research.
SUFFICIENT CONDITIONS FOR OPTIMALITY IN AN INFINITE HORIZON DEVELOPMENT PLAN
Alan S. Manne 1 May 1968 39 p refs
(Contracts N00014-67-A-0112-0011; N00014-67-A-0112-0016; AT(04-3)-326; DAHC04-67-C-0028; Grant NSF GP-6431)
(TR-68-7; AD-670616)

The paper begins by formulating a finite horizon linear programming model for economic development. This formulation allows for heterogeneous capital goods and for nonnegativity constraints upon investment in each sector. It is then proved that a certain set of conditions are sufficient to ensure that an optimal solution to this T period, finite horizon plan will also coincide with an optimal solution during the first T periods of an infinite horizon plan. Among the restrictive conditions imposed to prove this sufficiency theorem are the following: gradualist consumption paths, no primary factors that cannot themselves be produced within the economy, a Leontief technology, and a characterization of the optimal finite horizon solution as one in which the terminal investment and output levels are positive. An illustrative numerical example is provided. Author (TAB)

N68-31422*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INDEX OF SURVEYOR SCIENTIFIC PUBLICATIONS AND PRESENTATIONS
1 Jun. 1968 20 p refs
(Contract NAS7-100)
(NASA-CR-95995; JPL-PD-122, REV. C; JPL-602-16) CFSTI: HC$3.00/MF$0.65 CSCL 05B

Papers, reports, and oral presentations utilizing Surveyor lunar data are listed. The purpose of the document is to provide a historical bibliography and index of exposures of Surveyor to technical audiences up to the approximate time of termination of the Surveyor project. Author

N68-31479*# Techtran Corp., Glen Burnie, Md.
THE FIRST TREATY ON EXTRATERRESTRIAL SPACE [LE PREMIER TRAITE SUR L'ESPACE EXTRA-ATMOSPHERIQUE]
Manfred Lachs Washington NASA Aug. 1968 13 p refs Transl. into ENGLISH from La Comunita Intern. (It.), v. 22, no. 2, 1967 15 p Presented at It. Soc. for Intern. Organ., Rome, 17 Mar. 1967
(Contract NASw-1695)
(NASA-TT-F-11881) CFSTI: HC$3.00/MF$0.65 CSCL 22A

Recapitulation of major space events. Their effect on interhuman and international relations. Aerospace law based on but not analogous to maritime law. Early UN efforts at writing international space treaty on emergency aid, information exchange, responsibilities, ownership, tracking and probes and supplies in space. Disarmament, Nuclear Test Ban Treaty, extension of existing non-aggression and mutual defense pacts. A plea for sanity based on law. Author

N68-31519*# California Univ., Berkeley. Space Sciences Lab.
SYSTEMS ANALYSIS AND THE TECHNICAL WRITER'S GROWING RESPONSIBILITY
Ida R. Hoos Feb. 1968 15 p refs Presented at the 15th Intern. Tech. Commun. Conf. (Soc. of Tech. Writers and Publishers), Los Angeles, May 1968 ITS Internal Working Paper No. 83
(Grant NsG-243)
(NASA-CR-96132) CFSTI: HC$3.00/MF$0.65 CSCL 05B

The author evaluates aspects of transplanting systems analysis to civil matters. It is shown that all problems facing government decision makers and planners are multi-faceted, with the social causes and consequences probably the most crucial factors. The coordinated application of knowledge from many disciplines is absolutely necessary in helping the technical writer to deal with malfunctioning social systems. G.G.

N68-31604# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION, 1969
1968 286 p Index for Hearings of Comm. on Sci. and Astronautics, 90th Congr., 2d Sess. Supersedes HR-15086
(HR-15856; HR-15086)

Indexes are presented for the hearings before the House Committee on Science and Astronautics on H.R. 15086 during the second session of the 90th Congress. Both personal name and subject indexes are included for each of the (1) full committee, (2) manned space flight, (3) space science and applications, and (4) advanced research and technology. M.W.R.

N68-31658# Committee on Appropriations (U. S. Senate).
INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATIONS
1968 1474 p Hearings Before Subcomm. of Comm. on Appropriations, 90th Congr., 2d Sess.

Minutes of the hearing before the senate appropriations subcommittee cover the fiscal year 1969 budget of the Department of Housing and Urban Development G.G.

N68-31690# North American Rockwell Corp., Los Angeles, Calif.
FRONTIERS OF TECHNOLOGY STUDY. VOLUME 3: IMPLEMENTATION
M. A. Sulkin, T. R. Parsons, and D. I. Sinizer 5 Jan. 1968 491 refs
(Contract H-779)
(PB-178272) CFSTI: HC$3.00/MF$0.65

The report describes methods used for screening technologies and selecting technological areas for implementation requirement studies; discusses current technology status, urban transportation application, advantages, disadvantages, problems associated with application, research and development requirements, gross costs, and other factors bearing on the transferability of the selected technological areas; and makes specific recommendations with regard to these areas. Author (USGRDR)

N68-31703# North American Rockwell Corp., Los Angeles, Calif.
FRONTIERS OF TECHNOLOGY STUDY. VOLUME 2: SURVEY
M. A. Sulkin, T. R. Parsons, and D. I. Sinizer 5 Jan. 1968 266 p refs
(Contract H-779)
(PB-178271) CFSTI: HC$3.00/MF$0.65

The report documents the technology review portion of the program; describes the design of the literature review and field survey; briefly discusses the potentially transferable technologies identified; and lists sources of expertise for those technological areas. Author (USGRDR)

N68-31723# North American Rockwell Corp., Los Angeles, Calif.
FRONTIERS OF TECHNOLOGY STUDY. VOLUME 1: SUMMARY
M. A. Sulkin, T. R. Parsons, and D. I. Sinizer Jan. 1968 136 p refs
(Contract H-779)
(PB-178270) CFSTI: HC$3.00/MF$0.65

The objective of the study was to identify technology, particularly in defense and space-oriented fields, which would be transferable to 1973–80 urban transportation need and to delineate implementation requirements. The study was divided into three functional tasks: review of technology, screening of technology, and assessment and description of implementation requirements. This volume represents a summary of the entire program. Included are (1) a complete description of the program objectives, philosophy, and approach; (2) a summary of the surveyed technologies; (3) reviews of implementation requirements studies on 14 selected technological areas; and (4) a discussion of typical system applications. Also included are overall conclusions and recommendations regarding the development requirements and application of the various technologies for alleviation of some of the problems associated with improvement in urban transportation capability. Author (USGRDR)

N68-31738# Regional Planning Council, Baltimore, Md.
THE REGIONAL AIRPORT SYSTEM: A RECONNAISSANCE
Jul. 1967 99 p refs Sponsored by the Dept. of Housing and Urban Develop.
(PB-177801) CFSTI: HC$3.00/MF$0.65

The report is the first step leading to the preparation of a comprehensive plan for a regional airport system. The four basic purposes of the study are to: Identify the major problem areas and the need for future study; Begin the dialogue between aviation officials, airport operators, and planners that will be necessary for the development of a plan for a regional airport system; Bring together enough facts to obtain a well-rounded picture of the present need for aviation facilities as well as to make some preliminary projections of future needs; Begin laying the data base needed for plan preparation. Author (USGRDR)

N68-31738# Ohio State Univ., Columbus. College of Law.
INTERNATIONAL LEGAL PROBLEMS OF SCIENTIFIC RESEARCH IN THE OCEANS
William T. Burke Aug. 1967 146 p refs Sponsored by the Natl. Council on Marine Resources and Eng. Develop.
(PB-177724) CFSTI: HC$3.00/MF$0.65

The purpose of this study is to examine international legal problems actually or potentially involved in the conduct of scientific exploration and investigation of the marine environment and its resources, including the use of vessels, marine objects and structures for such purposes. Initially it is desirable (A) to specify the kind of activity subsumed under the rather broad term 'scientific exploration and investigation' in this context; (B) to attempt to place the legal framework for research in the context of the global requirements of such research; and (C) to comment upon the structure or organization of the study. Author (USGRDR)

N68-31865# Office of Aerospace Research, Arlington, Va.
AIR FORCE RESEARCH OBJECTIVES, 1968
1968 70 p
(OAR-68-0004; AD-671000)

The Office of Aerospace Research (OAR), as the prime research agency of the United States Air Force, conducts research within its own laboratories and, through its grants and contracts program, sponsors scientific research among the leading scientists of the free world. This latter research is encouraged in areas of Air Force interest. This publication is intended to stimulate researchers in free-world colleges, universities, and nonprofit and industrial organizations to participate in the Air Force research program. By delineating the various facets of the four major divisions (Physical Sciences, Engineering Sciences, Environmental Sciences, and Life Sciences) of the Defense Research Sciences, and by describing in detail the specific fields where additional research is required, OAR hopes to encourage outstanding members of the free-world scientific community to play a part in fulfilling Air Force research needs. Author (TAB)

N68-31889# Massachusetts Inst. of Tech., Cambridge.
TECHNOLOGY FOR HIGH SPEED GROUND TRANSPORT Research Summary Report, 16 Sep. 1966–15 Nov. 1967
Robert J. Hansen 31 Dec. 1967 57 p refs
(Contract C-85-65)
(PB-176923) CFSTI: HC$3.00/MF$0.65

This report contains highlights of research findings developed during the second year of research on the technology of high speed ground transport. The research topics are diverse but can be grouped roughly into areas relating to system operational performance, vehicles including suspension, propulsion and control, and the problems of the infrastructure of an High Speed Ground Transport system. The research is aimed at establishing a basis for design of high speed ground transportation and often treats problems not previously studied for conventional transportation systems. Author (USGRDR)

N68-31996# Naval Supply Depot, Mechanicsburg, Pa. Operations Analysis Dept.
VARIABLE OPERATING AND SAFETY LEVEL (VOSL) ANALYZER OPERATING MANUAL
Philip Kohlhass May 1968 75 p
(ALRAND-59; AD-670750)

Intuition based on experience has for many years been the main guideline for the manager in establishing policy. Currently, the inventory manager operates a complex system containing a number of interacting variables which must be properly adjusted to reflect his policies and yet remain within the constraints placed by higher authority. Mistaken judgments become evident after the fact unless the manager has some means of analyzing his policies as applied to his inventory. This manual describes a computer analyzer designed to provide him with pertinent statistics for comparing alternative management policies. It provides insight with less risk. Author (TAB)

N68-32091*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
MANAGEMENT: A SELECTIVE BIBLIOGRAPHY
14 Jun. 1968 142 p
(NASA-TM-X-61145; GP-532) CFSTI: HC $3.00/MF $0.65
CSCL 05B

A selective management bibliography is presented to give managers and students of management in the Kennedy Space Center community an overview and an awareness of Library resources in the management field. An author and subject index is included along with a list of periodicals wholly or partially devoted to management subjects. B.S.D.

N68-32093# National Aeronautical Establishment, Ottawa (Ontario).

AN IMPROVED THEORETICAL MODEL FOR THE GROUND DISTRIBUTION OF WATER RELEASED FROM A FIRE-BOMBER

J. I. Mac Pherson Feb. 1968 39 p refs

(NRC-10202; LR-498) CFSTI: HC$3.00/MF$0.65

Equations based on aircraft speed and altitude, tank geometry, and certain parameters of the erosion process are given for the discharge from the tanks, the erosion into droplets, and the resulting distribution on the ground of water released from a fire-bomber. A development of a previous theoretical model that displayed some weaknesses, the present model includes more realistic door-opening and discharge times and incorporates an erosion process in which the volume rate of production of droplets is dependent, not only on the area of bulk water exposed to the airstream, but also on the distance below the aircraft. Predicted solutions are matched to experimental data from tests of three aircraft, to numerically define proportionality factors used in the model. Equations are developed to estimate the width of the wetted area and to produce idealized contour patterns. The theoretical model is applicable to aircraft making drops between 75 and 110 knots at heights from 50 to 100 feet above the ground. Author

Collections of NASA Documents

NASA deposits its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below, is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington, Seattle

NASA publications are currently being forwarded to the public libraries in the cities listed below:

California: Los Angeles and San Diego
Colorado: Denver
Connecticut: Hartford
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul and Minneapolis
Missouri: Kansas City and St. Louis
New Jersey: Trenton
New York: Brooklyn, Buffalo, Rochester, and New York
Ohio: Cleveland, Cincinnati, Dayton, Toledo, and Akron
Oklahoma: Oklahoma City
Tennessee: Memphis
Texas: Fort Worth and Dallas
Washington: Seattle
Wisconsin: Milwaukee

In addition, NASA regularly sends its publications to the Enoch Pratt Free Library in Baltimore, Maryland, and the Wilmington Institute Free Library, Wilmington, Delaware.

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

OFFICIAL BUSINESS

FIRST CLASS MAIL

POSTAGE AND FEES P
NATIONAL AERONAUTIC
SPACE ADMINISTRATI

POSTMASTER: If Undeliverable (Sec
Postal Manual) Do N

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Notes, and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546

AND FEES P
AERONAUTIC
OMINISTRATI

liverable (Secti
Manual) Do Not

IONS

mation
d

n
ies.
ngs,
ks,

ology

pspace
riefs,
s,

ON